EXPERT REPORT OF STEVE MARTIN, Ph.D.

Marcellin and Estate of Hollowell v. HP Inc., and Staples, Inc.

United States District Court, Western District of New York

I. SUMMARY OF QUALIFICATIONS

1. I am currently employed as a Distinguished Professor of and University Professor of Materials Science and Engineering at Iowa State University, where my primary research includes the design, assembly, testing, and analysis of lithium ion batteries. I am one of only two Iowa State University professors to hold the two highest ranks of professorship at Iowa State University in the 165 year history of Iowa State University, the Anson Marston Distinguished Professor in Engineering and the University Professor. I have conducted more than 40 years of research and teaching experience in lithium-ion batteries and have received more than $28 million dollars in funding for my research in lithium and sodium battery design and development. I have taught courses at Iowa State University for 75 consecutive semesters, teaching more than 80 courses accruing more than 80,000 student hours of instruction. 40 of these course semesters were taught to advanced graduate students pursuing PhD degrees in Materials Science, Chemistry, and Physics, among other majors. I have co-taught courses in Energy Storage Systems, Batteries to graduate students in six different semesters.

2. I received my undergraduate Bachelors of Arts degree in Chemistry at Capital University in Bexley Ohio in May 1980. I then pursued a doctorate in physical chemistry at Purdue University in West Lafayette, Indiana. I received my Ph.D in physical chemistry from Purdue in August 1986.

3. While pursuing my Ph.D., from August 1980 to May of 1982, I was a Freshman Chemistry Teaching Assistant in the Department of Chemistry at Purdue University. I was promoted in May of 1982 to a Graduate Research Assistant where I worked until March of 1986.

4. Since March of 1986, I have worked at Iowa State University ("ISU"). I started as an Assistant Professor in the Materials Science and Engineering Department at ISU before being promoted to a full professor in July of 1996. In 2006, I was promoted to the rank of University Professor. Furthermore, in July of 2009, I was promoted to the Anson Marston Distinguished Professor in Engineering in the Department of Materials Science & Engineering at ISU. My research at ISU includes directed to lithium ion battery research, development, design, analysis, and testing.

5. In 1995, I was awarded a Research & Development R & D 100 award for one of the world's top 100 most important inventions for my development of a new class of Ultra-Low Expansion Optical Fibers for Laser Surgery. In 2002, I was elevated to the rank of Fellow of the American Ceramic Society in the Glass and Optical Materials and in 2003, I was awarded the ISU MSE Department Excellence in Service Award which was followed in 2005 by the MSE Excellence in Research Award and in 2009 by the MSE Excellence in Teaching Award. I am the only faculty member at Iowa State University in the 117 year history of the Department of Materials Science and Engineering to have been awarded all three MSE Department Excellence Awards.

6. In 2009, I was awarded the George W. Morey Award in Glass Science from the Glass and Optical Materials Division of the American Ceramic Society, recognized widely as the highest award in glass research in the world. In 2010, I served as the Chair of the Glass and Optical Materials Division where he has been an active member for the past 36 years. [INSERT].

7. I have also been a visiting professor to various universities around the world. For example, I was a visiting professor at: (1) Chalmers University of Technology in Goteborg Sweden in April of 2005; (2) Gyeongsang National University in Gyeongnam-Do South Korea in

2010 and 2012; (3) University of Messina in Messina, Italy in 2005 and 2013. While working as a visiting professor, I taught courses directed to lithium battery design and analysis including Fundamentals of Glass: Applications Towards a Greener Future."

8. In 2015, I was awarded American Ceramic Society, Ceramic Education Council, Outstanding Educator Award, recognized as the highest honor in Ceramic Education.

9. Based on my research on lithium-ion batteries (LIBs), I have published more than 235 articles on battery materials, and especially on battery electrolyte materials. My publications have generally focused on improving the safety and efficiency of batteries. Over my 40 years as a professor, I have also trained more than 220 students in batteries, battery safety, and battery materials. I have trained these students to assemble and test lithium batteries on a daily basis. At any one time in my research laboratory, I am testing approximately 50 batteries. Further, I have also consulted for many more than 50 companies and law firms on a wide range of subjects, including lithium battery fires and explosions. Finally, I have been awarded 7 different patents, three of which deal with electrochemistry and one of which deals specifically with electrolytes for batteries.

10. Of the more than $28 million in research funding that I have received over my more than 37 years at Iowa State, I have been awarded more than 100 different contracts and grants dealing with batteries, materials for batteries, and the performance and safety of batteries. In particular, I have received two grants from NASA to conduct collaborative research with NASA scientists totaling $1.5 Million. I have received two highly competitive ARPA-E grants from the Department of Energy to develop new kinds of solid electrolytes for lithium and sodium batteries totaling $6 Million. I have also received two grants from the Vehicular Technology Office of the Office of Energy Efficiency and Renewable Energy of the Department of Energy to

conduct new research to develop new thin film electrolytes for high performance batteries for electric vehicles totaling $1.9 Million. Finally, I have been continuously funded for more than 35 years by the National Science Foundation to conduct basis research on glassy solid electrolytes for solid state batteries as one of the only faculty members in the United States to receive such funding from the National Science Foundation.

11. I have frequently been retained as a technical expert and/or litigation consultant in cases involving lithium ion batteries. For example, I have been retained on matters of the design and development of lithium ion batteries and I have been retained on matters of the safety of lithium ion batteries, on both lithium ion battery explosions and lithium battery fires. Over the past approximately 20 years, I have been retained approximately 10 times in matters dealing with lithium ion batteries, their manufacturing, their properties and performances and their failures. I have been qualified as an expert and testified three times as an expert at trial. My C.V. is attached as Exhibit A.

II. PRIOR COURT AND DEPOSITION TESTIMONY

All of my legal consultation work is described in detail in Exhibit A beginning at page 73. In the past five years I have testified at the deposition in the matter where I was retained by Quinn Emanuel, LLC which involved lithium ion batteries and testified twice in court in that matter. I have also been deposed in the matter where I was retained by Greenspoon Marder, LLP in a matter related to glass failure.

III. HOURLY RATE OF COMPENSATION

My hourly rate of compensation for consulting on this case and preparing this report is $350 per hour.

IV. MATERIALS REVIEWED

A list of the materials reviewed to arrive at the opinions rendered in this report is attached as Exhibit B.

V. FACTS OF THIS CASE

The reports from the Allegany County Fire Service Investigation (15)[1], and Fire Research and Technology, LLC., (FRT) (13, 14) as well as my review of the deposition testimony of Carol Marcellin (16, at pp. 124-125), Lee Atkinson (8) and David Pipho (4), provide the following factual background upon which some of my opinions rely:

On January 24, 2020, a fire broke out at 192 Bells Brook Rd., in Ceres, NY at the home of Carol Marcellin and Charles Hollowell. The fire started in the office of the home as a result of an explosion of the battery pack of an HP Pavilion laptop computer ("subject laptop") and spread to other parts of the home. Ms. Marcellin was awakened by a smoke alarm and got out of bed to investigate. When she entered the office, she witnessed flames, smoke, and flaming projectiles being ejected from the laptop. She returned to the bedroom and tried to assist Mr. Hollowell out of the home. Mr. Hollowell was physically disabled and she was unable to extricate him, so she went to get help. She was unable to use the house phone and unable to find her cell phone in the smoke, so she tried to contact emergency services with the OnStar system in her vehicle. She could not get a signal at first but drove down the road until she did and was able to reach the OnStar operator who called 9-1-1. By the time first responders arrived it was too late to save Mr. Hollowell, who perished in the fire.

The Allegany County Fire Service Investigation and the investigation by FRT concluded that the laptop was the likely source of the fire. (13, 14, 15). The battery cells were ruptured with the contents of some of the cells ejected from the computer and found in other parts of the

[1] Parenthetical references are to documents identified in Exhibit B.

room. (14). Photos of the laptop after the fire provided by FRT are shown in Figures 1 and 2 below.

The laptop battery pack was not the original battery pack contained in the computer at the time it was purchased and appears to be an unauthorized or counterfeit battery pack. Markings on the battery pack printed circuit board appear to indicate this battery pack was manufactured in 2015, which is more than four years after the subject laptop was manufactured. (See Figure 3 below)

Figure 1 - Laptop after fire (FRT Photo)

Figure 2 - Bottom of laptop showing area of battery pack insertion (FRT Photo)

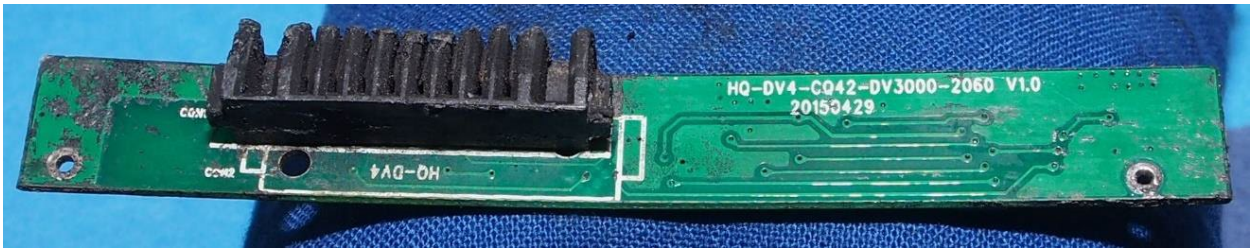

Figure 3 - Battery Pack Circuit Board (FRT Photo)

VI. PROPERTIES AND HAZARDS OF LITHIUM-ION BATTERIES

A. Fundamental Properties of Lithium-ion Batteries

Lithium-ion batteries (LIBs) utilize a negative electrode (anode) and positive electrode (cathode) to serve as hosts for the lithium ions (Li^+). Lithium ions move from the anode to the cathode during discharge and are intercalated into (inserted into voids in the crystallographic structure of) the cathode. The Lithium ions reverse direction during charging, moving from the cathode back to the anode to complete one discharge and one charge cycle. LIBs, such as the type of the subject battery in this case, are called rechargeable LIBs because they can support many hundreds of such discharge and charge cycles. However, during each such discharge and charge cycle, there is a microscopic degradation of the battery and the battery loses a tiny bit of

its capacity. Eventually, these little bits of capacity loss add up and the battery will not contain sufficient charge for the battery to be useful. At this point the LIB is termed as being "dead". Such degradation processes are a natural consequence of the 2nd Law of Thermodynamics.

Since lithium ions are intercalated into and therefore reside inside the anode and cathode host materials during charge or discharge, there is no free lithium metal within the lithium-ion cell. In a lithium-ion cell, alternating layers of anode and cathode are separated by a thin porous plastic film referred to as a "separator". An electrolyte composed of an organic solvent and dissolved lithium salt provides the media for lithium-ion transport between the anode and the cathode. Typical cylindrical cells are constructed by winding long strips of electrodes into a "jelly roll" configuration, which is then inserted into hard cases that are sealed with gaskets. By winding many layers, often as many as a hundred or more such three layer stacks, anode, separator, and cathode, battery manufactures can significantly increase the amount of energy that such battery cells can store.

Individual lithium-ion cells have safe voltage ranges over which they can be cycled as determined by cell chemistry. For typical LIBs, the voltage range is typically from about 4.2 V (fully charged, about 100% SOC) to about 3.5 V (discharged or about 0% SOC[2]). These LIBs typically exhibit a relatively flat discharge voltage profile from the charged state to the discharged state, so the nominal voltage (the average voltage the cell exhibits through most of its discharge) is usually in the range of about 3.6-3.7 V. For most cells, charging above 4.2 V. can lead to rapid, exothermic degradation of the electrodes and violent thermal runaway reactions. Likewise, discharging to below 3.5 V can also damage the electrodes and cause degradation reactions inside the LIB.

[2] State of Charge

Lithium-ion cells are typically incorporated into battery packs, which contain individual cells wired in series or parallel or both, together with integrated circuitry that provides what is frequently referred to as a battery management system. These systems include what is called a fuel gauge, which is a microprocessor that manages the battery system and provides protection against overcharge, overtemperature, overvoltage, over-discharge and also provides cell-balancing features. By connecting cells in parallel capacity is increased. By connecting sets of parallel-connected cells in series voltage is increased. So called 18650-sized cylindrical cells, those that are cylindrical in shape and are about 18 mm in diameter and are about 65 mm tall, are the typical cells utilized for laptop computer battery packs. Six of these cells connected in parallel pairs and then in series provide approximately 10.8 V and 4.5-5.0 Ah[3].

B. Evolution of Lithium-ion batteries

The lithium battery was first derived from the work of American physical chemist Gilbert Newton as far back as 1912. However, it took until the 1970s to commercially produce non-rechargeable lithium-ion batteries and another 20 years to commercially produce fully rechargeable lithium-ion batteries.

Since the first rechargeable LIBs came into common use in the early 1990s, the functional lifetimes and number of recharging events that LIBs can provide have consistently improved. In 2010, when the subject laptop was manufactured, battery life and the number of times a cell could be recharged were significantly less than what can be achieved today. This is important to the foreseeability of purchasers of devices such as laptop computers in that era seeking additional or replacement batteries to the one provided in the original laptop. Since the duration of the available charge from these battery packs manufactured during that era was

[3] The Ah is measure of electricity that a battery can store. 1 Ah is equivalent to 3600 coulombs of electricity.

significantly less than it is today, users who relied upon battery power frequently purchased backup battery packs that could be charged and held in reserve for when the initial battery pack was completely discharged. Similarly, since these battery packs had a limited number of recharges before failing, it was highly likely that replacement battery packs would be needed before the end of the useful life of the laptop. Indeed, these two aspects led to the common practice at the time of users buying and using multiple battery packs for their laptops. For this reason, it was common practice for laptop manufacturers to enable the swapping of battery packs in their laptops. Even this writer was familiar with this practice and would carry along backup battery packs for his laptop on extended travel away from his university.

C. Failure Modes, Thermal Runaway and Fire Hazard

Lithium-ion batteries can fail in both non-energetic and energetic modes. Typical non-energetic failure modes include loss of capacity, internal impedance increase (loss of rate capacity) and activation of permanent disabling mechanisms. These non-energetic failure modes are typically referred to as "benign failures" because these types of failures only result in a loss of function of the battery pack without creating a corresponding hazard to the device or the user.

"Thermal runaway" of a cell, on the other hand, is an energetic failure mode and refers to the rapid self-heating of a cell arising from the exothermic chemical reaction of the highly oxidizing positive electrode and the highly reducing negative electrode. In a thermal runaway reaction, a cell rapidly releases its stored energy. Lithium-ion batteries are particularly prone to energetic thermal runaway reactions because these cells have high energy densities compared to other commercially available battery chemistries and contain flammable organic liquid electrolytes. Self-heating in lithium-ion graphic anodes in the presence of electrolyte initiates at temperatures in the range of about 70 to 90º C. If a cell is brought to this initiating temperature

in an insulating environment (where not all of heat is effectively dissipated) it will eventually self-heat to the point where thermal runaway initiates.

For a given cell, the most severe thermal runaway reaction will be achieved when the cell is overcharged because the cell will contain maximum stored electrical energy. When a fully charged or overcharged lithium-ion cell undergoes a thermal runaway reaction a number of physical processes proceed simultaneously. Cell internal temperature increases dramatically, sometimes to in excess of 600º C. Temperatures produced by cell runaway reactions are considered sufficient to cause hot surface ignition of flammable mixtures, such as wood and paper. Cell internal pressure also increases because the heated electrolyte will both vaporize and decompose, and some cathode materials can also decompose, releasing gases in the process. The third process that occurs is referred to as cell venting. Cylindrical cells, such as the 18650 cells, have venting mechanisms installed in their cap assemblies that activate when internal pressures become high. Depending on the amount of oxygen present in the vicinity of the cell, the vented cell gasses can ignite. With hard case cells like those used for cylindrical laptop battery packs, internal pressure will build up prior to venting, and depending on the mechanical design of the cell, cell windings can be ejected. This phenomenon is common, especially in cylindrical cells without stiff center tubes. When these processes occur in a single cell in a multi-cell pack configuration, they are likely to propagate to other adjacent cells in the pack by way of various heat transfer mechanisms including direct case-to-case contact, impingement of hot vent gasses or impingement of flaming vent gases.

VII. SAFETY SYSTEMS EMPLOYED TO CONTROL HAZARDS

At the time the subject laptop was designed, the entire industry of lithium-ion battery manufacturers and manufacturers of devices utilizing lithium-ion batteries, were well aware of

and therefore recognized the danger of thermal runaway reactions in such LIBs. For this reason, HP and other laptop manufactures designed and/or required that certain safety systems be incorporated into battery packs that they were installing into their laptops to prevent these catastrophic reactions. Most laptop makers at the time were not battery cell manufacturers and as a result outsourced battery pack production to other manufactures. The specified battery pack for the Pavilion laptop in this case was required to include temperature sensing capability as well as safety functions to detect overcharge, over discharge, over voltage, over current, over temperature, reverse charge, cell imbalance and short circuit protection. (1, 2). Most of these safety systems required by HP and standard within the industry to prevent thermal runaway were incorporated through what is referred to as a fuel gauge or gas gauge. This device is an integrated circuit contained in the battery pack that provides a number of functions including detecting the level of charge in the cells. It also incorporates the safety features discussed above where if any of the safety parameters are exceeded, a field effect transistor (FET)[4] would disconnect power to the battery. (1, at pp. 5-6 of 12). Further, if the cell voltage exceeded 4.40 to 4.45V for 3-9 seconds, a fuse was designed to blow that would disconnect power to the battery pack. (*Id.*) Similarly, if the cell voltages between cells differed significantly, power would be disconnected through both a fuse blowing and switching off the C-FET. (*Id.*) The fuel gauge in HP's specification was required to have temperature sensing system employing a thermistor located near the cells. If this thermistor registered a temperature of 46º C for greater than two seconds, the fuel gauge would turn off the FET removing power from the battery pack. (*Id.*) The difference in function between the fuse and the FET is that for the former, once the fuse is blown, the battery pack would no longer be operable and would need to be replaced. For the

[4] The FET for the charging is referred to as C-FET and for discharge as D-FET. (1).

latter, the FET could be turned back on once the condition that caused it to turn off had returned to normal operating conditions.

Secondary (redundant) temperature sense capability was to be achieved through a thermistor placed between adjacent cells in the battery pack that relayed temperature data through Pin No. 6 directly connected to the motherboard. (1, 2, 3, 4). When this thermistor registered a temperature above 46º C, the internal controller in the motherboard disconnected power from the charger so the batteries could no longer be charged. (3; 4 at pp. 16-19).

When functioning properly, these safety systems greatly reduce, if not totally eliminate, the risk of thermal runaway. If the power is disconnected during charging once a cell reaches 46º C it cannot reach the threshold at which thermal runaway can begin, estimated as approximately 70 to 90º C.

VIII. BATTERY AUTHENTICATION SYSTEMS AND METHODS OF PREVENTING USE OF UNAUTHORIZED BATTERY PACKS

For the reasons discussed previously, and particularly during the era that the subject laptop was manufactured in 2010, it was common for laptop users to purchase either replacement battery packs when the useful life of the original battery pack was exceeded, or backup battery packs to use when the original battery pack was discharged during a period when the user could not connect to AC power. As recognized in a July 2005 publication by Texas Instruments "[t]his has opened a huge market for counterfeiters to supply cheap replacement batteries and peripherals that may not have the safety and protection circuits required by the original equipment manufacturer (OEM) … and can lead to a potentially dangerous situation for end-users." (5).

In this same 2005 TI publication, a number of battery authentication strategies and systems are discussed, which range from the simple to the more sophisticated. Unlike flashlight

batteries which come in uniform sizes, laptop battery packs are designed to fit into specifically designed spaces with specific and unique physical connections to the device. Thus, there is no one-size- fits-all battery pack that can be purchased to serve as a replacement or backup for the OEM supplied battery pack in these devices. Therefore, the most rudimentary protection against utilizing an unauthorized battery pack is the physical form of the battery pack. This, however, presents little to no obstacle to counterfeiters who will simply reverse-engineer an authorized battery pack to produce a cheaper version that is physically indistinguishable. These counterfeiters will also duplicate the labeling on the authorized pack and use identical labeling on the counterfeit so a purchaser will be misled into believing that the counterfeit is actually approved by the OEM.[5] (5)

At the time the subject laptop was manufactured, there were a number of more sophisticated battery authentication systems available that could be employed to discourage or prevent the use of counterfeit battery packs in devices such as the subject laptop. (*Id.*) The simplest of these works by the motherboard sending a command to read data from the battery pack. (*Id.*) The required data that must then be sent from the battery pack will include the product family code, identification number and cyclic redundancy check value. (*Id.*) If the data matches what the device expects, the battery pack is enabled. If not, preferably the device will not operate with this battery pack, or less optimally, the user will receive an error message on the screen indicating that the installed battery pack is not an authorized power source. This simple type of authentication system was available and in use in the industry for at least a decade prior to the manufacture of the subject laptop in 2010.

[5] This is what happened in the present case, where the unauthorized counterfeit battery pack was of the required form and used HP external labels.

The command and response authentication systems can be defeated by counterfeiters but at a cost. The data required to authenticate a battery pack for a particular manufacturer can be obtained from an authorized battery pack with an oscilloscope and then programmed into a counterfeit battery pack such that the counterfeit supplies the host device with the required data when the command is sent. As the 2005 TI Application Report explains, the command and response system indirectly provided security "by adding cost to the system. If cost is important, a non-OEM will opt for a battery or peripheral without this functionality."[6] (5).

A more sophisticated system available at the time the subject laptop was manufactured and referenced in the 2005 TI Application Report is a Challenge and Response Based system. (5) These systems change the query from the device and the response required from the battery pack each time and thus requires an identical device in the battery pack to generate a matching response to the query sent from the host device. The most sophisticated of these systems employ an SHA-1 based secure hash algorithm to generate a unique query requiring functionality in the gas gauge of the battery management system to generate an identical response to authenticate the battery pack. This system requires a larger investment by the counterfeiter and provides a greater disincentive to produce counterfeit battery packs for devices equipped with this system. (5).

The specification for the battery pack for the subject Pavilion Series laptop provided a choice of a number of different Texas Instruments gas gauges for use in these authorized battery packs. I was able to obtain the technical reference manuals for several of these gas gauges from Texas Instruments. (9-12). All of these gas gauges included the ability to authenticate using an SHA-1 algorithm when queried by a host device designed with this most sophisticated

[6] This is also what apparently occurred with the Pavilion series laptops. HP chose not to design the subject laptop with a battery authentication system making this model an easy target for counterfeiters.

authentication system. (9 at p. 69/187; 10 at p. 67/154; 11 at p. 67/153; 12 at p. 85/223). These reference manuals demonstrate that at the time the subject laptop was manufactured in 2010, not only was this type of sophisticated authentication system available and in use, but the gas gauges specified by HP for use in the battery pack of Pavilion laptops provided this sophisticated authentication functionality if HP had chosen to implement it. (5, 9-12).

Finally, another method employed by device manufacturers such as Apple when it produced the first iPod in 2001, is to seal the battery inside the device so that a user cannot replace or switch out a battery without sophisticated technical abilities. This method has the advantage of requiring a trained technician to replace the battery pack, making it much less likely that a counterfeit battery pack could be installed without user knowledge and also, depriving counterfeiters of a market of unsophisticated buyers.

IX. REVIEW OF RECOVERED BATTERY PACK COMPONENTS

I have personally examined the remnants of the battery pack from the subject laptop. This included the circuit board with attached fuel gauge which formed the battery management system, as well as remnants of the battery cells. I have also reviewed CT imaging of the laptop after the fire and before it was disassembled. (6).

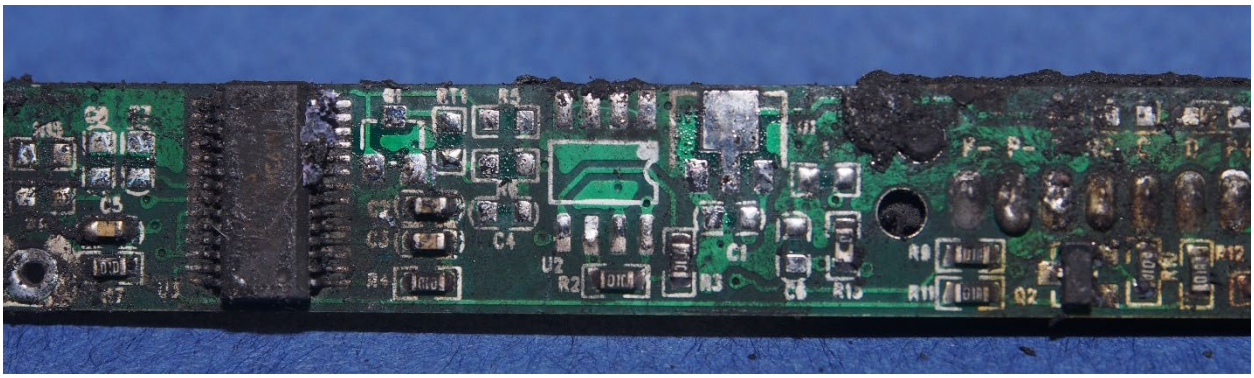

Figure 4 Battery Management System recovered from Laptop

The circuit board and fuel gauge are shown in Figure 4 above. The gas gauge (fuel gauge) is shown in closeup view in Figures 5 and 6 below. Markings on this gas gauge indicate it is a Texas Instruments bq2060a SBS v1.1-Compliant Gas Gauge IC. (see Figure 6). This is not one of the Texas Instruments gas gauges specified by HP for the Pavilion series battery packs, rather it is a less sophisticated version also manufactured by TI. (1). I reviewed the TI specification for this bq2060a gas gauge to determine its functionality. (7). Although not one of the HP specified gas gauges for use in its authorized Pavilion series battery packs, the TI bq2060a does have much of the functionality required by HP in its specification. However, an examination of the circuit board from the battery pack recovered from the subject laptop indicates that much of the safety functionality available in this gas gauge was not implemented in the recovered battery management system. In other words, although the bq2060a gas gauge had temperature sensing and cell balancing capabilities, the pins on the gauge providing this functionality were not connected to anything on the printed circuit board to provide this protection. Specifically, pins 15-19 were not connected, meaning there was no charging FET control (pin 16) to disconnect the power when dangerous overvoltage or overcharge conditions arose and no temperature sense control (pin 19) connected to a thermistor to provide cell temperature data to the gas gauge. Pins 15 and 16 were intended to be connected to a fuse to provide secondary protection against overtemperature and overcharge events but were not connected so this secondary protection was also not implemented on the subject battery pack. (See 7, at p. 17).

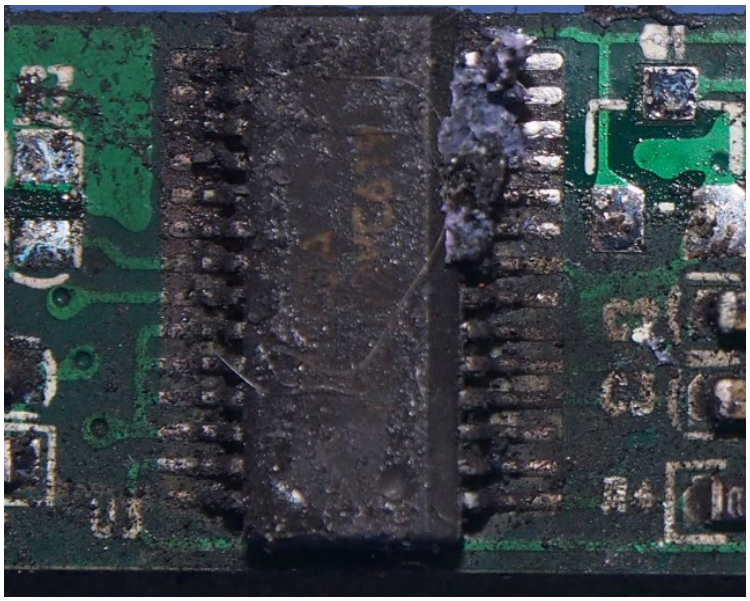

Figure 5 - TI bq2060A fuel gauge

Figure 6 - Close up showing TI bq2060a identifying markings

As discussed above, the subject laptop was also designed with a secondary temperature sensing system that was comprised of a thermistor located near the battery cells that was intended to send temperature data directly to the motherboard of the laptop through pin number 6 of the battery connector. (1, 3, 4). The circuit board shows no evidence of a connection through pin number 6 of the battery connector to a secondary thermistor or to any other device.

This bq2060A gas gauge also had the capability of sending unique data on the battery pack to the motherboard for it to identify the battery pack as one authorized for use in the laptop. (7 at p. 36). This functionality is described in the 2005 Texas Instruments Application Report as the simplest of the query and response battery authentication systems. (5 at p. 2). Even if this functionality in the bq2060A gas guage had been enabled, the subject laptop was not designed with such an authentication system so it would have been a useless function to identify unauthorized battery packs. (1, 4, 8).

Figure 7 below is CT imaging of the laptop after the fire showing the two remaining battery cells which are both ruptured. (6) Figures 8 and 9 below show recovered fragments of the battery cells that were ejected from laptop during the thermal event and were recovered in other parts of the room. (13) The battery cell debris demonstrates classic signs of a thermal runaway reaction in these battery cells.

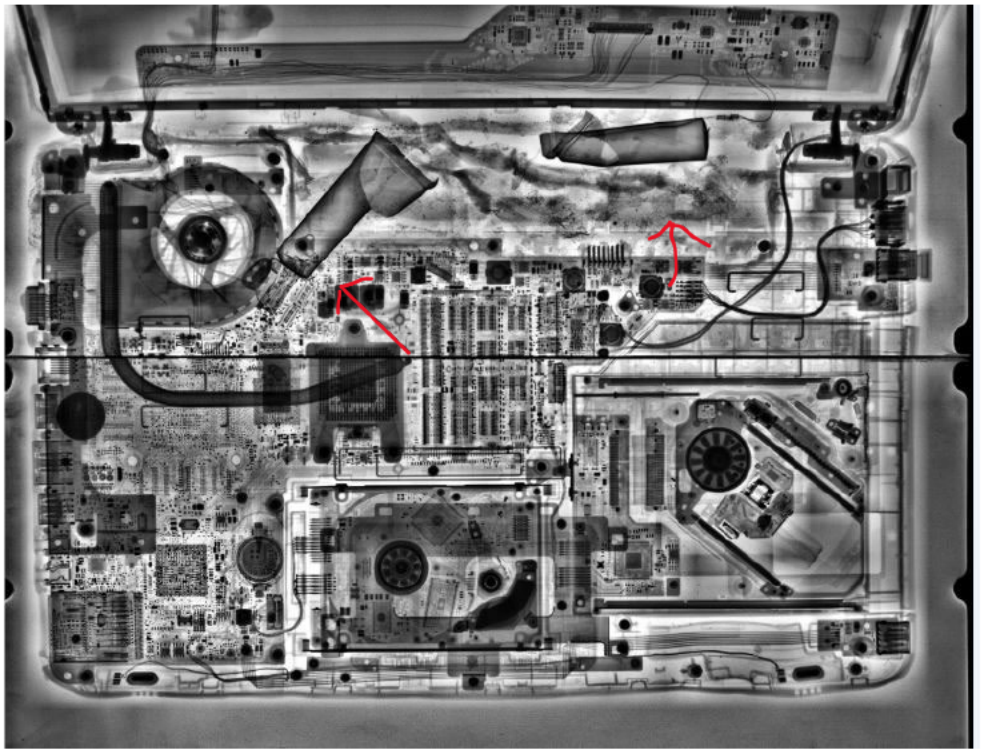

Figure 7 - CT Image of Laptop showing remaining battery cells ruptured (6)

Figure 8 - ejected battery cells

Figure 9 - Ejected Battery Cell

X. OPINIONS AND BASIS OF OPINIONS

Based upon my review of the materials described above and listed in Exhibit C, together with my education, training and experience in material science and engineering, and my specific experience in studying the design of LIB cells and battery management systems, I have reached the following opinions to a reasonable degree of scientific and engineering certainty:

A. At the time the subject HP Pavilion laptop was designed and manufactured, it was foreseeable and likely, that a replacement battery pack would be utilized during the anticipated lifespan of the device.

As discussed at length in section VI. (B) above, in the time period the subject laptop was designed and manufactured, it was foreseeable and expected that users of this laptop would seek replacement or backup batteries to use in this laptop during its useful life. It was the typical experience of users that the run times of typical LIBs used in laptops such as the subject HP Pavilion laptop were often such that "dead batteries" in need of replacement was a common experience. Indeed, laptops at the time were designed by manufacturers such as HP to accommodate the short run time of their batteries by enabling easy user-initiated replacement of the laptop LIBs. Further, even I have the experience of buying extra batteries for my laptop from the laptop manufacturer to use during periods when I used my laptop without access to AC charging.

B. At the time the subject HP Pavilion laptop was designed and manufactured, it was known within the industry that replacement battery packs for laptop computers and other devices utilizing lithium-ion batteries were counterfeited and sold at prices below prices charged for authorized replacement battery packs.

As discussed at length in section VII above, and as documented in reference 5 published by Texas Instruments in 2005, it was well known in 2010 and for the decade prior that LIB packs were being counterfeited and sold below the market price of authorized replacement battery

packs. It was also known that some of these counterfeit and unauthorized battery packs lacked the safety systems designed into the authorized battery packs to prevent thermal runaway reactions from occurring from overcharging or cell imbalances, because inclusion of these safety systems added to the cost of the counterfeiter and the lack of these safety systems would not be obvious to the purchaser. (5). The deposition testimony of Lee Atkinson and David Pipho documents that HP was aware of the widespread sale and dangers of these counterfeit battery packs by at least 2014. (4, at p. 34-37, 40; 8 at pp. 92-95, 99-103, 131). The industry had been well aware of such use and dangers for many years prior to 2010. (5).

C. The fire at issue in this case was caused by cell overcharge or overvoltage causing one or more cells in the battery pack to reach excessive temperatures and prompting a thermal runaway reaction.

As discussed at length in section VI. (C) above, a thermal runaway reaction can occur when the temperature of a cell reaches in excess of 70º- 90 C. Based upon the analysis of FRT (13, 14) and the statement and testimony of Carol Marcellin describing the scene when she saw the laptop spewing flaming projectiles (15, 16), as well as my inspection of photographs of the remnants of the computer and my review of the remnants of the battery cells, one or more cells experienced thermal runaway prompting other cells to react similarly. This occurred due to several possible causes including cell imbalance or a defect in one of the cells.

D. The unauthorized battery pack that caused the fire lacked overcharge, overvoltage, and overtemperature safety features intended to reduce or eliminate the risk of thermal runaway.

Based upon my review of the battery pack printed circuit board and gas gauge, pin numbers 15-19 of the TI bq2060a gas gauge in the battery pack in the subject laptop were not enabled. Pin 16 was intended to operate the C-FET that would have shut down power from the charger if overcharge, overvoltage, overtemperature or any of the other conditions occurred that

pursuant to the battery pack specification required shutoff by the FET and disconnection of the battery pack from the charger. (7) This pin was also intended to trigger the secondary protection system by blowing the fuse in the event the primary system failed. (*Id.*) Pin 19 on the TI bq2060a gas gauge was intended to connect to a thermistor to monitor the temperature of the cells. (*Id.*) Without this pin being implemented, this primary temperature sensing system was not enabled. There is also no evidence that the redundant thermistor that was intended to communicate directly to the motherboard in the specification through pin number 6 of the battery connector pinout was present or enabled. Had there been an operable thermistor connected through pin number 6, the internal controller in the motherboard would have shut off power to the battery pack as described in HP's interrogatory answers and amplified by the testimony of Mr. Pipho. (3, 4, at pp. 54-62). This would have prevented the battery cell(s) from reaching the temperature threshold for thermal runaway. Because the battery pack lacked other safety features, it is unlikely this thermistor was present and enabled. However, if the opposite is assumed, then the laptop motherboard and internal controller malfunctioned.

E. Had the overcharge, overvoltage and overtemperature safety features specified by HP for this battery pack been functioning, thermal runaway and the resultant fire would not have occurred.

As discussed at length in section VII. above, the battery pack specification for this Pavilion series laptop required certain protection systems designed to shut down power to the battery pack when overcharge and/or overvoltage conditions occur and when the temperature within the cells reaches 46º C. (1). The TI bq2060a gas gauge on the battery management board recovered from the subject laptop offered most of these protection features but none of them were enabled (they lacked connections from the appropriate pin on the gas gauge to the printed circuit board). Had these safety protection systems been enabled and functioned as designed, the

cell temperature could not have reached the point where thermal runaway would occur and the explosion of the battery pack and the fire resulting therefrom would not have occurred.

F. The subject laptop was defectively designed in that it lacked any battery authentication system or other design that would have prevented the user from unknowingly operating the subject laptop with an unauthorized battery pack

As discussed at length in section VIII. above, there were a number of available battery authentication systems that could feasibly have been designed into the subject laptop that would have detected the unauthorized battery that caused this fire. As discussed previously, the TI gas gauges listed in the HP specification for the battery pack for this device had functionality to implement an SHA-1 type authentication system, which is one of the more advanced systems in use at the time. (1, 5, 9-12). HP affirmatively chose not to employ any of these available systems at the time it designed and manufactured the subject laptop and did not incorporate any warning system for the user that an unauthorized battery pack was installed until 2019 when it implemented a pop-up message in its newly manufactured laptops. (8 at pp. 107-108). This decision not to utilize available authentication technology in its laptops until 2019 encouraged counterfeiters to manufacture and sell unauthorized battery packs for this and other series HP computers because there was no added cost required to defeat the non-existent battery authentication system. (5).

There were additional ways HP could have designed the subject laptop to prevent or discourage the use of unauthorized battery pack replacements. As discussed in section VII. above, HP required a secondary overtemperature detection system, duplicative of the one provided by the fuel gauge, which reported temperature data directly to the motherboard through pin number 6. (1, 3, 4). HP could have designed a safety system to disconnect power to the battery pack using the internal controller not only when the intended thermistor indicated the

temperature exceeded 46° C, but also if no temperature data was transmitted through pin number 6 to the motherboard if the battery pack did not have such a thermistor enabled or if it malfunctioned. Mr. Pipho testified this was a feasible design that HP could have implemented. (4, at pp. 54-61).

Finally, HP could have followed the design utilized by Apple as early as 2001 of sealing the battery pack inside the device so that users could not replace the battery pack without taking it to a qualified service dealer. This would prevent users from inadvertently purchasing unauthorized replacements, but as importantly, would discourage counterfeiters from manufacturing replacement battery packs for these devices since it is unlikely there would be a market for unauthorized battery packs when only authorized service centers and appropriately trained and skilled technicians were capable of removing and replacing the battery packs. Mr. Pipho testified that this option was discussed within HP but was never implemented. (4 at pp. 37-39; 8 at 122-123).

Dated: October 14, 2024

Steve W. Martin

VITA

September 2024

I. PERSONAL DATA

Name:	Steve Warthen Martin
Address: Office -	2220BF Hoover Hall, ISU, Ames, IA 50011-1096 (515) 294-0745 swmartin@iastate.edu
Home -	1912 Leopold Drive, Ames, IA 50010-4496 (515) 450-1823
Birthdate/Place:	July 21, 1958; Mt. Vernon, OH
Citizenship:	USA
Original Date of Employment:	March 24, 1986
Graduate Faculty Status:	Full Member, 1990

II. EDUCATION

B.A. Chemistry, Capital University, Bexley, OH, May 1980
Ph.D. Physical Chemistry, Purdue University, West Lafayette, IN, August 1986

III. ACADEMIC EXPERIENCE

5/2024	Visiting Scientist, Johnson Energy Storage, Atlanta, GA
4/2024	Visiting Professor, Muenster Electrochemical Energy and Technology Center, University of Muenster, Muenster, Germany
3/2024	Visiting Scientist, Chemical Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN
1/2024	Visiting Professor, Faraday Institute for Energy Storage Research, University of Oxford, Oxford, United Kingdom
11/2014	Visiting Professor, Center for Research, Technology and Education in Vitreous Materials, LaMAV, Department of Materials Engineering, Federal University of São Carlos, São Carlos, Brazil
1/2013	Visiting Professor, Department of Physics, University of Messina, Messina, Sicily, Italy
1/2012	Visiting Professor, Department of Materials Science and Engineering, Changwon National University, Changwon, Gyeongnam-Do, South Korea
2/2012	Visiting Professor, Department of Materials Science and Engineering, Gyeongsang National University, Jinju, Gyeongnam-Do, South Korea
1/2010	Visiting Professor, Department of Materials Science and Engineering, Changwon National University, Changwon, Gyeongnam-Do, South Korea
1/2010	Visiting Professor, Department of Materials Science and Engineering, Gyeongsang National University, Jinju, Gyeongnam-Do, South Korea
7/2009 - present	Anson Marston Distinguished Professor in Engineering, Department of Materials Science & Engineering, ISU
1/2009	Visiting Professor, Department of Materials Science and Engineering, Changwon National University, Changwon, Gyeongnam-Do, South Korea
7-12/2009	Co-Director, Zero Carbon Energy Systems Research Center Working Group, College of Engineering, Iowa State University
7/07- 6/08	Director of Graduate Education, Department of Materials Science & Engineering, ISU
7/2006 - present	University Professor, Department of Materials Science & Engineering, ISU
7/2006	Visiting Professor, Department of Applied Physics, Kumoh National Institute of Technology, Gumi, Korea
10/2005	Visiting Professor, Department of Physics, University of Messina, Messina, Italy
4/2005 – 8/2005	Visiting Professor, Department of Applied Physics, Chalmers University of Technology, Göteborg, Sweden
7/1996 – present	Full Professor, Materials Science & Engineering Department, ISU
7/1991 – 6/1996	Associate Professor, Materials Science & Engineering Department, ISU
3/1986 - 6/1991	Assistant Professor, Materials Science & Engineering Department, ISU
5/1982 - 3/1986	Graduate Research Assistant, Department of Chemistry, Purdue University
8/1980 - 5/1982	Freshman Chemistry Teaching Assistant, Department of Chemistry, Purdue University

IV. INDUSTRIAL AND OTHER NON-ACADEMIC EXPERIENCE

10/2008 – present Associate Staff Member, Ames Laboratory, Division of Materials Science & Engineering
10/2004 – 9/2008 Associate Staff Member, Ames Laboratory, Division of Materials Engineering and Physics
1/1993 – 9/2004 Associate Staff Member, Ames Laboratory, Condensed Matter Physics Division
5/1986 – 12/1992 Associate Staff Member, Ames Laboratory, Metallurgy & Ceramics Division
3/1986 – 7/1991 Assistant Professor, Engineering Research Institute, Iowa State University

V. HONORS AND AWARDS

- International Commission on Glass, Technical Committee 03 Structure of Glass, Member, June 2018 – present.
- International Commission on Glass, Executive Council Member, October 2015 – present
- Certificate of Distinction, Exemplary Service as a Faculty Mentor, Iowa State University, March 2022
- Certificate of Service, 35 years of Continuous Service to Iowa State University, February 2022
- Sigma Xi, Iowa State University Chapter, Past-President, May 2018
- Sigma Xi, Iowa State University Chapter, President, June 2017 – May 2018
- Sigma Xi, Director of Comprehensive Colleges and Universities Constituency, December 2015 – 2018
- Sigma Xi, Member of the Executive Board of Directors, December 2015 – 2018
- Iowa State University, Sigma Xi Chapter, Executive Committee, June 2015 – 2018
- American Ceramic Society, Ceramic Education Council, Outstanding Educator Award, 2015
- American Ceramic Society, Glass and Optical Materials Division, Chair of the Glass and Optical Materials Division, October 2011
- Iowa State University, Sigma Xi Chapter President Award, April 2011
- Iowa State University, Department of Materials Science & Engineering, Akinc Excellence in Teaching Award, April 2010
- Anson Marston Distinguished Professor in Engineering, Department of Materials Science & Engineering, ISU, September 2009
- American Ceramic Society, Glass and Optical Materials Division, George W. Morey Award in Glass, May 2008
- Iowa State University, Engineering Student Council Leadership Award, January 2007
- Aalborg University, Department of Chemistry, Aalborg, Denmark, Ph.D. Final Examination Faculty External Examiner, March 2007
- University Professor, Department of Materials Science and Engineering, Iowa State University, September 2006
- American Men and Women of Science, December 2005
- Honda Research Initiation Award, Honda Research of America, November 2004 – November 2005
- Chalmers 175th Anniversary Jubilee Professorship, Visiting Professor, Department of Applied Physics, Chalmers University of Technology, Göteborg, Sweden, May - August 2005.
- Faculty Improvement Leave, Iowa State University, "Chalmers University 175th Jubilee Professorship," Chalmers University of Technology, Göteborg, Sweden, May –August 2005
- Iowa State University, Department of Materials Science & Engineering, Excellence in Research Award, April 2005
- Siemens-Westinghouse Competition, Outstanding Mentor Award, Siemens-Westinghouse, Siemens Foundation, January 2005
- Chalmers University of Technology, Department of Physics, Göteborg, Sweden, Ph. D. Final Examination Faculty Opponent, January 2004
- Academic Keys Who's Who in Sciences Higher Education, January 2004
- Iowa State University, Department of Materials Science & Engineering, Excellence in Service to the Department Award, April 2003
- Iowa State University, Honors Program, Faculty Recognition for Teaching Award, April 2003
- Iowa State University, Student Activities Center, Faculty Recognition for Teaching Award, April 2003
- American Ceramic Society, Fellow of the Society, May 2002
- Chalmers University of Technology, Department of Physics, Göteborg, Sweden, Ph. D. Final Examination, Faculty Opponent, December 2002

- Iowa State University, College of Engineering Patent Recognition Award for United States Patent # 6,177,372 “Preparation of High Density Metal Fluoride Glasses with Extended Ultraviolet and Infrared Ranges, and such High Density Heavy Metal Fluoride Glasses,” Steve W. Martin, Jesse Huebsch, November 2001
- Iowa State University, Student Activity Center, “Outstanding Undergraduate Student Club Advisor,” April 2000
- Iowa State University, College of Engineering Patent Recognition Award for United States Patent # 5,829,445 “Methods for Laser Treatment of Tissue”, Steve W. Martin, and Gerald J. Shirk, November 1999
- Iowa State University, College of Engineering Patent Recognition Award for United States Patent # 5,755,850, “Method of Making a Surgical Laser Fiber from a Monolithic Silica Titania Rod”, Steve W. Martin, and Gerald J. Shirk, October 1998
- Iowa State University Inventors Award for “Development of Ultra-Low Expansion ULE Laser Optical Fiber for Laser Surgery", May 1997
- Research & Development R & D 100 Award for 1995 "Development of Ultra Low Expansion ULE Laser Optical Fiber for Laser Surgery", September 1995
- Selected as Iowa State University Iowa State Fair main exhibit, “New Laser Optical Fibers for Laser Surgery,” August 1995
- Iowa State University Research Foundation Award for Early Achievement in Research, May 1991
- National Science Foundation Travel Award Recipient, Travel to NATO Advanced Study Institute, "Science and Technology of Fast Ion Conductors," Erice, Sicily, Italy, July 1987
- National Science Foundation Travel Award Recipient, Travel to NATO Advanced Stud Institute, "Current Topics in Glass," Tenerife, Spain, May 1984
- Sohio Research Fellow, January 1984 to January 1985, Purdue University, Department of Chemistry
- Outstanding Graduate Teaching Assistant, Phi Lambda Epsilon Award, Purdue University, Department of Chemistry, May 1983
- Outstanding Senior in Chemistry, American Institute of Chemists Award, Capital University, May 1980
- Chemistry Representative for Battelle Memorial Institute summer internship program for undergraduate science students summer 1978 (continued internship through graduation), May 1978 - August 1980

VI. ACADEMIC AREAS OF SPECIALIZATION

Teaching:

MSE 202	Processing of Materials, 2 Cr., S’99
MSE 346X	Problems in Materials Science, 3 Cr., S'87, S'88
MSE 345L	High Temperature Processes Laboratory, S'88, S'89, S'90, S'91
MSE 347	Vitreous State, 3 Cr., S'94, S'95, S’96, S’97, S’98, S’99
MSE 347L	Vitreous State Lab, 1 Cr., S'94, S'95, S’96, S’97, S’98, S’99
MSE 360	Thermochemistry for Materials Science & Engineering, 3 Cr., F'92, F'93, F'94, F'95, F’96, F’97
MSE 421	Materials Engineering Design, 3 Cr. S’00, S’01
MSE 445	Ceramic Engineering Design I, 3 Cr., F'90, F'91
MSE 446	Ceramic Engineering Design II, 3 Cr., S'89, S'90, S'91, S'92, S'93
MSE 501	Thermodynamics of Physico-Chemical Processes in Solids, 3 Cr., F'86, F'87, F'88, F'89, F'90, F'91
MSE 520	Thermodynamics and Kinetics in Multicomponent Materials, F’09, F’ 10, F’11
MSE 528	Advanced Vitreous State, 3 Cr., F’98, S’03, S’07
MSE 530	Solid State Science, 3 cr. S’18, S’19
MSE 533	Materials Characterization, 3 Cr., F’94, F’97, S’00, S’04, S’06, S’07
MSE 551	Materials Characterization, 3 cr. S’09, S’11, S’13, S’15, S’17, S’23
MSE 575	Advanced Vitreous State, 3 Cr., S'92, F'95

MSE 590	Special Topics "Advanced Vitreous State," S'08, F'08, S'09, S'11, S'12, S'14, S'15, F'22
MSE 620	Phase Transformations, 3 Cr. S'08, S'10, S'14, S'16
MSE 690	Special Topics "Advanced Materials Characterization," S'11
MSE 699	PhD Research Credits, 2,592 Cr, F'1988-Su'224
Mat E 213	Vertically Integrated Design, 1 Cr., F'99, F'00, F'01, F'02
Mat E 214	Materials Characterization, 3 Cr., S'02
Mat E 313	Vertically Integrated Design, 2 Cr., F'99
Mat E 322	Ceramic Processing, 3 Cr., S'20, S'21, S'22
Mat E 413	Vertically Integrated Design, 2 Cr., F'99
Mat E 414	Materials Engineering Design, 2 Cr. S'00, S'01, S'02
Mat E 423	Glass Science and Engineering, 3 Cr., F'99, F'00, F'01, F'02, F'03, F'04, F'05, F'06, F'07, F'08, F'09
Mat E 425	Glass and Advanced Ceramics, 3 Cr., F' 10, F'11, F'12, F'13, F'14
Mat E 425	Glass Science and Engineering, 3. Cr., F'15, F'16, F'17, F'18, F'19, F'20, F'21, F'22
Mat E 490	Special Topics "Advanced Vitreous State," F'11, S'12, S'14, S'15, S'16
GRST 565	Responsible Conduct of Research, F'13, F'14, F'15
ME 433	Alternative Energy Conversion, F'08, co-taught with Professors Vik Dalal, Ganesh Rajagopalan, Mark Bryden, and Robert Anex
ME 531	Advanced Energy Systems and Analysis, guest lecture on electrochemical energy storage systems F'13, F'15, F'16, F'17, F'18, F'19
Short Courses	"Fundamentals of Glass: Applications Towards a Greener Future," Department of Materials Science & Engineering, Changwon National University, Changwon, Gyeongnam-Do, South Korea, January, '10 "Fundamentals of Glass: Applications Towards a Greener Future," Department of Materials Science & Engineering, Gyeongsang National University, Jinju, Gyeongnam Do, South Korea, January, '10 "Glass Science and Engineering," Department of Materials Science & Engineering, Changwon National University, Gyeongnam-Do, South Korea, January, '09

Research Interests and Areas:

Glass formation, structure, properties and dynamics in oxide and non-oxide glasses
Ionic transport in glass and dependence on glass microstructure and chemistry
Sodium batteries for grid-scale energy storage
Lithium batteries for portable energy storage
Glassy solid electrolytes for solid state lithium and sodium battery applications
High capacity reversible anodes for lithium battery applications
Ceramic proton conducting membranes for proton membrane fuel cells
Relaxations in glass, electrical, magnetic, mechanical and thermal stresses probed by impedance and NMR spectroscopies, Brillouin light scattering and scanning calorimetry
The liquid to glass transition

VII. GRANTS AND CONTRACTS

Funded: (Current funded total $27,832,158 as of August 2024)

142. National Science Foundation, Division of Materials Research, "Preparation and Characterization of New Ultra-High Na+ Ion Conductivity Mixed Glass Former Mixed Oxy-Sulfide-Nitride Glassy Solid Electrolytes," $640,000 (PI), August 1, 2024 – July 31, 2028

141. “Iowa State Presidential Initiative in Battery Research,” ISU, Co-PI, SWM Share $30,769, total awards $400,000.

140. Department of Energy, Pacific Northwest National Laboratory, “Development of Thin, Robust, Lithium-Impenetrable, High-Conductivity, Electrochemically Stable, Scalable, and Low-Cost Glassy Solid Electrolytes for Solid State Lithium Batteries that Meet Battery500 Consortium Targets,” $900,000 1/1/2023 – 12/31/2025 (PI).

139. Johnson Energy Storage, “Development of New Glassy Solid Electrolytes,” $200,000, 10/1/2022 – 9/30/2023 (PI).

138. National Science Foundation, Engineering Division, Chemical, Biological, and Environmental Technology Program, “EAGER: New Lithium Oxy-ThioBorate Solid Electrolytes,” $300,000, Proposal number 2234046, September 1, 2022– August 31, 2025 (PI).

137. National Science Foundation, Division of Materials Research Ceramics Program, Supplement to “Convergence in Mixed Oxy-Sulfide-Nitride Glassy Solid Electrolytes: A Transformative and Enabling Complexity Towards Advanced Materials,” $49,067, Proposal number 1936913, 8/1/2022 – 8/31/2023 (PI).

136. National Science Foundation, Division of Materials Research Ceramics Program, MPS GRSV Supplement to “Convergence in Mixed Oxy-Sulfide-Nitride Glassy Solid Electrolytes: A Transformative and Enabling Complexity Towards Advanced Materials,” $67,092, Proposal number 2214110, (PI).

135. Iowa State University, College of Engineering, “Acquisition of a Multi-functional Multi-Material Ultra-High Sensitivity Wide Temperature Range Auto-Sampling and Auto-Loading Differential Scanning Calorimeter to Advance the Research Capability and Productivity of Seven Research Groups in the College of Engineering and be a College and University Wide Resource,” $70,000 with $9,270 cost-share, August 31, 2021 – August 30, 2022 (PI)

134. National Science Foundation, Division of Materials Research Ceramics Program, Supplement to “Convergence in Mixed Oxy-Sulfide-Nitride Glassy Solid Electrolytes: A Transformative and Enabling Complexity Towards Advanced Materials,” $59,021, Proposal number 213583, 8/1/2021 – 7/31/2022 (PI).

133. National Science Foundation, Division of Materials Research, “MRI: Acquisition of a Multi-Functional Multi-Material Wide-Wavelength-Range Fourier Transform Infrared Spectrometer for Materials Characterization - Track 1,” $293,560 with $125,812 in Cost-Share (PI) September 1, 2021 - August 31, 2023

132. Department of Energy, EPSCoR Implementation Grant, “Development and Testing of New All-Solid-State, Ultra-Safe, Ultra-Low-Cost, High-Energy-Density, Anode-Free Sodium Battery Systems for Grid-Scale Energy Storage,” Department of Energy Pre-proposal $2,999,999 with $750,000 cost share (PI)(Accepted)

131. Iowa State University, Department of Energy EPSCoR Implementation Grant, “Development of New All Solid State Ultra-Safe Low-Cost High-Energy Density Sodium Battery Systems for Grid Scale Energy Storage,” Internal ISU Pre-Proposal Competition, $3,000,000 (PI)(Accepted)

130. NASA EPSCoR Program, “Research Capacity Building Program In Iowa: Developing New High Energy Density Extremely Safe All Solid-State Lithium-Sulfur Batteries,” $749,999 with $375,000 cost-share, (PI) July 1, 2020 – June 30, 2025.

129. “Development of New All Solid-State Lithium Batteries for Next Generation Mission Enabling Energy Storage Systems,” Iowa NASA EPSCoR Program, Iowa State University, 12/16/19 – 08/14/20, $28,840, including $15,360 matching. (PI)

128. National Science Foundation, Division of Materials Research Ceramics Program, Supplement to “Convergence in Mixed Oxy-Sulfide-Nitride Glassy Solid Electrolytes: A Transformative and Enabling

Complexity Towards Advanced Materials," $57,623, Proposal number 1936913, 8/1/2020 – 8/31/2021 (PI).

127. National Science Foundation, Division of Materials Research Ceramics Program, "Convergence in Mixed Oxy-Sulfide-Nitride Glassy Solid Electrolytes: A Transformative and Enabling Complexity Towards Advanced Materials," $639,995, Proposal number 1936913, 12/1/2019 – 11/30/23 (PI).

126. KBR, "Iowa State University Work in Support of American Oxygen," $60,000, July 1, 2019 – September 30, 2019 (PI).

125. Department of Energy, Energy Efficiency and Renewable Energy, Vehicular Technologoies Office, Advanced Vehicle Technologies, "Development of Thin, Robust, Lithium-Impenetrable, High-Conductivity, Electrochemically Stable, Scalable, and Low-Cost Glassy Solid Electrolytes for Solid State Lithium Batteries," $1,000,000 with $252,595 cost share, Control Number 2014-1507, 12/1/2019 – 11/30/2022, (PI).

124. Iowa Energy Center, Iowa Department of Economic Development, "Development of Low Cost, Safe, and High Performance Sodium Batteries for Wind Energy Storage," Proposal number 307352, April 19, 2019, $480,656 with $120,278 cost share, total $600,934, 4/1/2020 – 3/31/ 2024

123. Advanced Research Projects Agency – Energy (ARPA-E), "Development and Testing of New, Strong, High Li+ Ion Conductivity, Li-Impermeable Thin-Ribbon Glassy Solid Electrolytes for Lithium Metal Batteries," $2,500,000 including $287,750 (cash) cost share, February 1, 2017 – July 31, 2020. (PI).

National Science Foundation, Division of Chemical, Bioengineering, Environmental, and Transport Systems, Energy for Sustainability Program, "SusChEM: Ultra-High Li^+ Ion Conductivity Chemically Stable Mechanically Strong Mixed Oxy-Sulfide Solid Electrolytes, "$300,000, September 1, 2014 – August 31, 2020, (PI).

National Science Foundation, Division of Materials Research, Ceramics Program, "Diametric Extremes in Ionic Conductivity of Mixed Glass Former Solid Electrolytes," $510,000, 8/1/2013 – 7/31/2020 (PI).

National Science Foundation, Division of Materials Research, Ceramics Program, AGEP Graduate Research Assistant Supplement to "Diametric Extremes in Ionic Conductivity of Mixed Glass Former Solid Electrolytes," $62,933, 7/1/2017 – 6/30/2018, (PI).

Department of Energy, Advanced Research Project Agency – Energy (ARPA-E) "OPEN 2015", "Low-Cost, Low-Temperature, Safe, High-Energy-Density Solid-State Na Batteries Made from Renewable Materials," $2,950,000 with $327,745 cost-sharing, February 1, 2016 – June 30, 2018, (PI)

Honda Research Institute of America, "Development of New Lithium Ion Conducting Glassy Solid Electrolytes, $30,000, June 30, 2016 - February 28, 2017(PI).

National Science Foundation, Division of Materials Research, Ceramics Program, AGEP Graduate Research Assistant Supplement to "Diametric Extremes in Ionic Conductivity of Mixed Glass Former Solid Electrolytes," $63,723, 1/1/2016 – 12/31/2016, (PI).

Honda Research Institute of America, "Development of New Lithium Ion Conducting Glassy Solid Electrolytes, $170,000, January 1, 2015 – June 30, 2016 (PI).

National Science Foundation, Division of Materials Research, Ceramics Program, AGEP Graduate Research Assistant Supplement to "Diametric Extremes in Ionic Conductivity of Mixed Glass Former Solid Electrolytes," $59,901, 8/1/2014 – 7/31/2015, (PI).

Arizona State University, subcontract from Sandia National Laboratory, Department of Energy, Office of Electricity Energy Storage Systems Program, "Strategies for Liquid Anode Alkali Batteries of High Energy Density operating at 0 to 100ºC," $170,000, ISU share $87,500, March 20, 2014 – August 31, 2015, (Co-PI, PI C. Austen Angell, ASU).

The Charles Stark Draper Laboratory (Cambridge, MA), "Solid State Alkali Atom Source (SSAAS), $125,000, March 1, 2014 – February 28, 2015 (PI).

Iowa State University, Foreign Travel Grant, Conference and Research Participation, Germany and South Korea, $1,433, March 14, 2014 – September 30, 2014(PI).

NASA Jet Propulsion Laboratory, "Preparation and Assembly of Solid State Lithium Batteries," $55,110, February 13, 2014 – August 1, 2014, (PI).

U. S. Department of Energy, Idaho Operations Office, "Novel High Temperature and Radiation Resistant Infrared Glasses and Optical Fibers for Sensing in Advanced Small Modular Reactors," $800,000, ISU Share as subcontract from Clemson University, January 13, 2014 – December 12, 2017, $300,000, (co-PI)

National Science Foundation, Division of Materials Research, Ceramics Program, AGEP Graduate Research Assistant Supplement to "Diametric Extremes in Ionic Conductivity of Mixed Glass Former Solid Electrolytes," $59,975, 8/1/2013 – 7/31/2014, (PI).

Iowa State University, "Materials for BioSphere Energy Systems and Technologies: M-BEST MRSEC," ISU NSF-MRSEC Internal Pre-Proposal, $12,407,670, (Accepted by ISU) (PI).

NASA EPSCoR, Kennedy Space Center, "Towards Next Generation Lithium Sulfur Batteries for Mission Enabling Energy Storage Systems," $750,000 with additional $375,000 cost share from ISU, 2/1/2013 – 1/31/2016, (PI) (Co-PI S. Beckman)

National Science Foundation, Division of Materials Research, AGEP Graduate Research Assistant Supplement to "Materials World Network: An International Education and Research Program in the Use of the Mixed Glass Former Effect to Study Ion Conductivity in Solid Electrolytes," $75,091, September 1, 2012 – August 31, 2013, (PI)

Iowa State University, College of Engineering, Request for Strategic Initiative Funding, "Acquisition of an Electrochemical Renewable Energy Storage Systems Characterization Facility," $75,000 with $25,000 cost share, 1/1/2012 – 6/30/2012, (PI).

Sandia National Laboratory, Department of Energy, Office of Electricity Energy Storage Systems Program, "Strategies for Liquid Anode Alkali Batteries of High Energy Density operating at 0 to 100ºC," $600,000, ISU share $300,000, May 1, 2011 – April 30, 2014, (Co-PI, PI C. Austen Angell, ASU).

LYNNTECH, Incorporated, "Preparation and Characterization of Solid Electrolytes for Lithium Batteries," May 1, 2010 – April 30, 2011, $80,000 (PI).

National Science Foundation, Division of Materials Research, Supplement to "Materials World Network: An International Education and Research Program in the Use of the Mixed Glass Former Effect to Study Ion Conductivity in Solid Electrolytes," $100,000, July 31, 2010 – August 1, 2010, (PI)

Ames Laboratory, Seed Grant Proposal, "Preparation and Characterization of New *in situ* Carbon Coated Nanometric Core-Shell Intermetallic Particulate Alloys as High Capacity Reversible Li Anodes," $50,000 January 2, 2009 – December 31, 2010, (PI)

Air Force Office of Scientific Research, "Preparation and Characterization of Chalcogenide glasses for Infrared Fiber for Conversion & Routing," SBIR Phase 2 with Agiltron Corporation, March 1, 2009 – October 31, 2010, $170,000.

Iowa State University, College of Engineering, "Renewable Energy Proposal Development and Planning Grant," $45,000, (Co-PI with Jonathan Wickert), July 1, 2008 – June 30, 2010.

ISIS, Science and Technology Facilities Council, Proposal for Neutron Diffraction Beam Time, "Structure of glasses based on mixed glass-formers," Proposal Reference No: 820144, A. Matic, S. W. Martin, M. Karlsson, L. Borjesson, Instrument: SANDALS, Exposure time (days): 5

National Science Foundation, Division of Materials Research, REU Site Program, "REU Site: Materials Education and Research on Far-From-Equilibrium Materials, Structures, Properties, and Processes," April 1, 2008 – March 31, 2011, $273,000, (PI).

Air Force Office of Scientific Research, "Preparation and Characterization of Chalcogenide glasses for Infrared Fiber for Conversion and Routing," SBIR with Agiltron Corporation, November 1, 2007 – October 31, 2008, $30,000.

Air Force Office of Scientific Research, "New Mid-IR Rare Earth Chalcogenide Glass Fiber Laser," SBIR project with SPIRE Corporation, Bedford, MA, and Clemson University, subcontract, May 1, 2007 – April 30, 2008, $18,000 (Co-PI with K. Linden (Spire) and J. Ballato (Clemson).

National Science Foundation, Division of Materials Research, Materials World Network Program, "Materials World Network: An International Collaborative Educational and Research Program in the Study of Mixed Glass Former Phenomena in Materials," August 1, 2007 – July 31, 2011, $1,009,000 (PI)

Roy J. Carver Trust, "Acquisition of a Comprehensive Impedance Spectroscopy System for Renewable Energy and Materials Research," November 1, 2007 – October 31, 2008, $472,896, $52,440 ISU Cost share, (PI)

Iowa State University NSF PFI Preproposal Competition, "Ceramic Membrane Fuel Cells (CMFCs) - Towards Zero-Emission Transportation: A Partnership for Innovation between ISU, the State of Iowa, and the Honda Corporation," National Science Foundation Partnerships for Innovation Program, April 1, 2007 – March 30, 2010, $600,000 (PI) (Approved)

"Acquisition of a Thermal Analysis Suite for Self-healing Composites, Bulk Metallic Glass, and Ionically Conducting Glass," Department of Defense University Research Instrumentation Program, Army Research Office, $176,835, April 1, 2006 to March 31, 2007. (co-PI with Michael Kessler).

NASA Langley Research Center, Iowa State University Center for Smart Materials, "Bragg Gratings in Chalcogenide Glass Multimode Optical Fibers: Towards Higher Sensitivity Strain Sensors and *In Situ* Health Monitoring of Morphing Airframes," January 1, 2006 – August 31, 2006, $83,082 (PI)

Argonne National Laboratory, Intense Pulsed Neutron Source, Beam Time Proposal, "Structural investigation of glasses in the system $0.5Li_2S + 0.5[(1-x)GeS_2 + xGeO_2]$ system," January 31, 2006 – August 31, 2006 (PI)

Iowa State University Foreign Travel Grant "Faculty Improvement Leave at Chalmers University, Göteborg, Sweden, $1,088, 3/25/2005 (PI)

Chalmers University of Technology, Göteborg, Sweden, Department of Applied Physics, "Study of the Proton Dynamics in a New Class of Oxy-Sulfide Proton Conducting Ceramics for Use in Intermediate Temperature H_2-O_2 Fuel Cells," May 1, 2005 – August 31, 2005, 423,000 SEK ($USD 60,400) to support Faculty Improvement Leave from ISU at Chalmers University (PI)

Honda Corporation of America, "Development of New Ceramic Proton Exchange Membranes for H_2-O_2 Fuel Cells for Use in Advanced Power and Transportation Applications," Honda Research Initiation Grant, 2004, November 1, 2004 – October 31, 2005, $50,000 (PI)

National Science Foundation, Division of Materials Research, "Evaluation of the Optical and Electrical Properties of Oxy-Chalcogenide Glass Materials," May 1, 2003 – April 30, 2007, $315,000 (ISU share) (Co-PI with Himanshu Jain, Lehigh, and Kathleen Richardson, Clemson), November 1, 2003 – September 30, 2007, (co-PI).

NASA Langley Research Center, Iowa State University Center for Smart Materials, "Bragg Gratings in Chalcogenide Glass Multimode Optical Fibers: Towards Higher Sensitivity Strain Sensors and *In Situ* Health Monitoring of Morphing Airframes," July 1, 2003 – December 2005, $175,100 (PI)

National Aerospace Agency, John H. Glenn Research Center, "Development of Chemically and Thermally Robust Lithium Fast Ion Conducting Chalcogenide Glasses," March 1, 2004 – February 28, 2005, $75,000 (PI).

Argonne National Laboratory, Intense Pulsed Neutron Source, Beam time Proposal #4263, "Structure Determination of $xNa_2S + (1-x) B_2S_3$ Glasses Using Neutron, November 2005. (PI)

National Science Foundation, Division of Materials Research, Division of International Programs, "Supplemental Request for International Collaboration through a Research Experiences for Undergraduates," $8,750 February 1, 2004 – December 31, 2004 (PI).

National Science Foundation, Division of Materials Research, Instrumentation for Materials Research Program, "Acquisition of a Comprehensive High Temperature and High Purity Glove Box Materials Processing Facility for Education and Research," October 1, 2003 – September 30, 2004, $200,000 with $90,000 ISU match (PI, with D. Cann, K. Constant, and X. Tan).

National Science Foundation, Division of Materials Research, "Dynamics and Structure in Complex Disordered FIC Electrolytes: Is there a Maximum Ionic Conductivity in the Solid State", Supplement, $35,000, June 14, 2003 – June 13, 2004 (PI)

Argonne National Laboratory, Intense Pulsed Neutron Source, Beam time Proposal #3955, "Structure Determination of $xNa_2S + (1-x) B_2S_3$ Glasses Using Neutron Scattering, April 23, 2003. (PI)

National Aerospace Agency, John H. Glenn Research Center, "Development of Chemically and Thermally Robust Lithium Fast Ion Conducting Chalcogenide Glasses," January 14, 2003 – January 13, 2004, $75,000 (PI).

NASA Jet Propulsion Laboratory, "High Stability, High Conductivity Solid Electrolytes for Long Life and High Specific Energy Li-Ion Batteries," Sub-Contract on Director's Research and Development Fund Project, January 1, 2003 – December 31, 2004, $100,000 (PI)

Department of Energy, Golden Field Office, Hydrogen Program, "Design and Development of Glass-Ceramic Proton Conducting Electrolytes," $194,574 with $38,296 Cost share, July 14, 2002 – September 30, 2004.

National Science Foundation, Division of Materials Research, Instrumentation for Materials Research Program, "Acquisition of Comprehensive Multiple Wavelength Laser Raman Spectrometer for Materials Education and Research," October 1, 2002 – September, 30, 2003, $150,400 with $72,000 ISU match (PI, with D. Cann, and V. Dalal, Co-PIs).

NASA Langley Research Center, Iowa State University Center for Smart Materials, "Bragg Gratings in Chalcogenide Glass Multimode Optical Fibers: Towards Higher Sensitivity Strain Sensors and *In Situ* Health Monitoring of Morphing Airframes," July 1, 2002 – June 30, 2003, $240,000, (PI)

National Science Foundation, Division of Materials Research, "Dynamics and Structure in Complex Disordered FIC Electrolytes: Is there a Maximum Ionic Conductivity in the Solid State", $120,000, 7/13/2002 – 6/30/2004, (PI)

The Department of Defense, Defense University Research Instrumentation Program, "Acquisition of a Wide Frequency Range Fourier Transform Infrared Spectrometer System," April 1, 2002 – March 31, 2003, $199,780 (PI)

Department of Energy, Ames Laboratory, Metallurgy and Ceramics Program, "Acquisition of a State of the Art Differential Scanning Calorimeter for Glass Transition Studies of Metallic Glasses," $53,653, April 1, 2002 - March 30, 2003 (PI).

National Science Foundation, Division of Materials Research, "Dynamics and Structure in Complex Disordered FIC Electrolytes: Is there a Maximum Ionic Conductivity in the Solid State", Research Experiences for Undergraduates and Sputter-Coater Acquisition Supplement, $24,000, April 1, 2002 – June 13, 2003 (PI)

Office of Naval Research, "Development of New Fast Proton Conducting Chalcogenide Glassy Electrolytes," $200,000, January 1, 2002 – September 31, 2003 (PI).

Argonne National Laboratory, Intense Pulsed Neutron Source, Beam time Proposal #3792, "Structure Determination of Ag-B-S Glasses Using Neutron Diffraction, 5 days, May 3, 2002.

Department of Energy, Office of Energy Efficiency and Renewable Energy "Design and Development of Nano-Engineered Proton Conducting Glass-Ceramic Membranes," $137,287, with $34,391 ISU cost-share, 10/01/01- 9/30/02. (PI)

Argonne National Laboratory, Intense Pulsed Neutron Source, Beam time Proposal #3608, "Structure Determination of Ag-B-S Glasses Using Neutron Diffraction," 3 days, November 26, 2001 (PI).

Iowa State University, Carver Trust Grants, "Synthesis of New Silver and Barium Thioborate Non-Linear Crystals for Use as Mid-Infrared Lasers for Application in Optical Fiber-Based Information Technologies", $25,000, 7/1/01 – 6/30/02, (PI)

National Science Foundation, Division of Materials Research, "Dynamics and Structure in Complex Disordered FIC Electrolytes: Is there a Maximum Ionic Conductivity in the Solid State", $120,000, 7/13/2001 – 6/30/2002, (PI)

National Science Foundation, Division of Materials Research, "Dynamics and Structure in Complex Disordered FIC Electrolytes: Is there a Maximum Ionic Conductivity in the Solid State", Research Experiences for Undergraduates Supplement, $16,000, May 14, 2001 – June 3, 2002, (PI)

National Aerospace Agency, John H. Glenn Research Center, "Development of Chemically and Thermally Robust Lithium Fast Ion Conducting Chalcogenide Glasses," January 14, 2001 – January 13, 2002, $99,921 (PI).

Office of Naval Research, "Development of New Fast Proton Conducting Chalcogenide Glassy Electrolytes," $151,514 with $7,600 ISU Cost sharing, July 1, 2000 – December 31, 2001 (PI).

National Science Foundation, Division of Materials Research, "Dynamics and Structure in Complex Disordered FIC Electrolytes: Is there a Maximum Ionic Conductivity in the Solid State", Research Experiences for Undergraduates Supplement, $6,500, June 4, 2000 – June 3, 2001, (PI)

Office of Energy Efficiency and Renewable Energy, Department of Energy, Broad Based Solicitation DE-PS36-00GO10482, "Design and Development of Nano-Engineered Glass-Ceramic Proton Conducting Membranes for Hydrogen-Oxygen Fuel Cells," $135,969, July 15, 2000 – July 14, 2001, with $33,993 ISU cost share, (PI)

Office of Naval Research, "Development of New Fast Proton Conducting Chalcogenide Glassy Electrolytes," $105,135, 3/31/1999 - 4/1/2000 (PI).

National Science Foundation, Division of Materials Research, "Dynamics and Structure in Complex Disordered FIC Electrolytes: Is there a Maximum Ionic Conductivity in the Solid State", Research Experiences for Undergraduates Supplement, $14,376, 7/15/1999 – 6/3/2000, (PI).

National Science Foundation, Division of Materials Research, "Dynamics and Structure in Complex Disordered FIC Electrolytes: Is there a Maximum Ionic Conductivity in the Solid State," $240,000, 7/15/1999 – 6/3/2001, (PI).

National Science Foundation, Division of Materials Research, “Dynamics and Structure in Complex Disordered FIC Electrolytes: Is there a Maximum Ionic Conductivity in the Solid State”, REU Supplement $14,376, 7/15/1999 – 6/3/2000, (PI).

Sandia National Laboratory, “Preparation of ^{17}O-Enriched Glassy P_2O_5”, 6/6/ 1998 - 6/5/199, $7,153, (PI).

National Science Foundation, Division of Materials Research, Research Experiences for Undergraduates (REU) Supplement to “Dynamics and Structure of New Alkali Thioborate Glasses: Nanoscale Affects of Length and Time,” 1/1/1997 - 4/31/1997, $10,000 (PI).

National Science Foundation, Division of Materials Research Opportunity Award (ROA) Supplement to “Dynamics and Structure of New Alkali Thioborate Glasses: Nanoscale Affects of Length and Time,” 4/1/1997 - 3/31/1998, $25,842 (PI)

National Science Foundation, Division of Materials Research, "Dynamics and structure of new chalcogenide glasses: Nanoscale effects of length and time," REU Supplement, 4/1/96-12/31/1996, $9,000 (PI).

Manufacturing and Technology Center, National Institute of Standards and Technology (NIST), Center for Advanced Technology Development, and Full Spectrum, Inc., "Development of new coatings for use with laser optical fibers for use in laser surgery," 6/1/1996 - 12/31/1996, $34,650, (PI).

NASA Iowa Space Grant Consortium, “Preparation and Characterization of High Density Heavy Metal Fluoride Glasses as Scintillation and Cerenkov Detectors”, Graduate Fellowship for Jesse Huebsch, 5/1/1996 - 8/31/1996, $4,000 (PI)

NASA Iowa Space Grant Consortium, “Preparation and Characterization of Low Tg Phosphate Glasses for Use With Polymer Glass Blend Composites”, Undergraduate Research Assistantship for Jeremy Schrooten, 5/1/1996 - 8/31/1996, $1,600 (PI)

National Science Foundation, Division of Materials Research, "Dynamics and structure of new chalcogenide glasses: nanoscale effects of length and time," REU Supplement, 4/1/95-3/31/1996, $3,160 (PI).

MolTech, Corporation, "Preparation and Characterization of New Nanoscale Powders of Glassy Fast Ion Conductors", $14,754, 1/1/1996 - 12/31/1996, (PI)

National Science Foundation, Division of Materials Research, "Acquisition of a Comprehensive Dynamic Thermal Analysis System", $220,000, with $110,000 ISU match, 10/1/1996 - 9/31/1998, (PI)

National Science Foundation, Division of Materials Research, "Dynamics and structure of new chalcogenide glasses: Nanoscale effects of length and time," 4/1/95-3/31/98, $255,000, continuation, (PI).

National Science Foundation, Division of Materials Research, "Acquisition of a FT-Raman spectrometer," $139,340 with $69,670 ISU match, 10/1/95 -9/31/98, (PI).

"Preparation of High Density Fluoride Glasses for use as Cerenkov Radiators", Iowa State University Research Foundation, October 15, 1995 - January 15, 1996, $6,000. (PI)

National Science Foundation, "Development of a new undergraduate laboratory methodology: Real time fast scanning x-ray diffractometry," $162,110 with $81,055 ISU match, 10/1/95 - 9/30/96, (Co-PI).

National Institute of Health, Small Business Technology Transfer Program (STTR) with Full Spectrum, Inc., "Development of optical fiber preforms for new U.L.E. laser optical fibers," $100,000, 7/1/95 - 6/30/96, (Investigator).

Manufacturing and Technology Center, National Institute of Standards and Technology (NIST) with CATD/ISU and Full Spectrum, Inc., "Development of new coatings for use with laser optical fibers for use in laser surgery," 11/1/94 - 3/31/95, $35,800, (PI).

National Science Foundation, Division of Human Resources, "RCMS: A minority engineering program at ISU," 7/1/94 - 6/30/95, $167,000, continuation, (Co-PI).

Manufacturing and Technology Center, National Institute Standards and Technology (NIST) with CATD/ISU and HeartLand Software, "Development of impedance spectroscopy software," 6/1/94 - 3/31/95, $23,000 (PI).

National Science Foundation, Division of Materials Research, "Dynamics and structure of new chalcogenide glasses," 5/31/94 - 3/31/95, $40,000, continuation, (PI).

Center for Advanced Technology Development, ISU, "Development of next generation laser optical fibers for laser surgery," 1/31/94 - 12/31/95, $20,000, continuation, (PI).

Full Spectrum, Inc., "Development of next generation laser optical fibers for use with Nd:YAG laser systems in surgical applications," 12/31/93 - 12/31/94, $40,000, continuation, (PI).

Sandia National Laboratories, "Preparation and characterization of anhydrous binary alkali Ultra-phosphate glasses," $5,000, 12/13/93 - 9/31/94 (PI).

National Science Foundation, Division of Materials Research, "Dynamics and structure of new chalcogenide glasses," $35,000, supplement, 8/31/93 - 9/1/94, (PI).

National Science Foundation, "RCMS: A Minority scholar program in Engineering at ISU," 7/1/93 - 6/30/94, $167,000, (Co-PI).

National Science Foundation, Division of Materials Research, "Dynamics and structure of new chalcogenide glasses," $80,000, 4/1/93 - 3/31/94 (continuation), (PI).

National Science Foundation, "A new paradigm for teaching undergraduate materials synthesis and processing," $350,000, 1/1/93 - 12/31/95 (Investigator).

Center for Advanced Technology Development, ISU, "Development of next generation laser optical fibers," $50,000, 1/1/93 - 12/31/93 (continuation), (PI).

Full Spectrum, Inc., "Development of next generation laser optical fibers for use with Nd:YAG laser systems in surgical applications," $295,185 (continuation), 1/1/93 - 12/31/93 (PI).

Sandia National Laboratories, "Preparation and characterization of anhydrous binary alkali phosphate glasses," $10,000, 10/1/92 - 4/1/93 (PI).

National Science Foundation, "RCMS: A minority scholar program in engineering at ISU," $160,226, 7/1/92 - 6/30/93 (continuation), (Co-PI).

National Science Foundation, Division of Materials Research, "REU: Dynamics and structure of new chalcogenide glasses," $11,000, 5/15/92 - 5/14/93 (PI).

Sandia National Laboratories, "Preparation and characterization of anhydrous binary alkali phosphate glasses," $10,000, 5/15/92 - 9/30/92 (PI).

National Science Foundation, Instrumentation and Laboratory Improvement Program, "Development of a new undergraduate laboratory methodology: Interactive PC-based scanning electron microscopy," $98,775 - with matching from ISU, 5/1/92 - 4/30/94 (Co-PI).

Iowa State University, "Project Vincent 1992: Proposal for the Upgrade of DS2100 to DS5000/125 (PI).

Texas National Research Laboratory Commission, "Preparation and characterization of new high density fast scintillating glasses for the SSC," $180,000, with ISU match of $18,000, 3/1/92 - 2/28/93 (PI).
Center for Advanced Technology Development, ISU, "Development of next generation laser optical fibers," $50,000, 11/1/91 - 12/31/92 (PI).

Sandia National Laboratory, "Preparation and characterization of anhydrous binary alkali phosphate glasses," $10,000, 9/30/91 - 9/29/92 (PI).

International Business Machines - Graduate Student Fellowship, "NMR studies of alkali thioborate glasses," $18,900, 8/30/91 - 8/29/92 (PI).

Iowa State University, Project Vincent 1991, "Acquisition of One DEC 5000 Color Workstation," 7/1/91 - 6/30/92 (PI).

Iowa State University, Project Vincent 1991, "Acquisition of two PC 386 workstations," 7/1/91 - 6/30/92 (PI).

National Science Foundation, Division of Materials Research, "Dynamics and structure of new chalcogenide glasses," $140,000, 4/1/91 - 10/31/92 (PI).

Texas National Research Laboratory Commission, "Preparation and characterization of new high density fast scintillating glasses for the SSC," $180,000, with ISU match of $68,100, 3/1/91 - 2/28/92 (PI).

Full Spectrum, Inc., "Development of next generation laser optical fibers for use with Nd:YAG laser systems in surgical applications," $295,185, 1/1/91 - 12/31/92 (PI).

Iowa State University, College of Engineering, "Preparation of new high density scintillating glasses for the SSC," $5,400, 10/1/90 - 6/30/91 (PI).

Sandia National Laboratory, "Preparation and characterization of anhydrous binary alkali phosphate glasses," $29,992, 10/1/90 - 9/30/91 (PI).

Iowa State University, Project Vincent 1990, "Acquisition of one DEC 3100 color workstation," 7/1/90 - 6/30/91 (PI).

Iowa State University, University Grants Program, "Development of a reactive oxide materials processing facility in the Department of Materials Science and Engineering," $7,500, 7/1/90 - 6/30/91 (PI).

National Science Foundation, "Research careers for minority scholars: A minority scholar program in engineering at Iowa State University," $1,378,815, 1/1/90 - 12/31/94 (Co-PI).

Ames National Laboratory, "Search for very dense, fast rare earth scintillators for use at the SSC," $11,200, 9/1/89 - 9/30/89 (Co-PI).

Iowa State University, College of Engineering, "Preparation and characterization of new 8-14 μm IR transmitting high Tg chalcogenide glasses," $3,000, 7/1/89 - 6/30/90 (PI).

NATO, Division of Scientific Affairs, "Preparation and Characterization of New Superionically Conducting Selenide Glasses," $7,090, 4/l/88 - 5/31/91 (PI).

National Science Foundation, "Preparation and Characterization of New Chalcogenide Glasses," $247,950, 2/1/88 - 7/31/91 (PI).

National Science Foundation, "Multinuclear NMR Investigations of Superionically Conducting Glasses: A Swiss-American Collaborative Project," $10,200, 1/1/88 - 6/30/90 (PI).

Iowa State University, University Grants Program, "Development of Reactive Materials Processing Facility in the Department of Materials Science & Engineering," $2800, 5/15/87 - 6/30/88 (PI).

Research Corporation, Cottrell Research Grant, "Chemical Restructuring Processes in Alkali Phosphate Liquids," $12,000, 1/1/87 - 12/31/88 (PI).

Iowa State University Minigrant, "Al_2S_3-based Glassy Solid Electrolytes," $500, 7/1/86 - 6/30/87 (PI).

Submitted - Pending or Not Funded: (**Current Total Pending $481,114 as of August 2024)**

National Science Foundation, Division of Materials Research, "MRI: Track #1 Acquisition of an Advanced Multi-Functional Wide Frequency and Wide Excitation Wavelength Range Raman Micro-Spectrometer for Materials Characterization," $481,114 (PI) August 1, 2024, July 31, 2027 (Pending)

Department of Energy, EPSCoR Implementation Grant, "Fundamental Studies of All Solid State Sodium Battery Materials: Towards Enabling Low-Cost, Energy-Dense, and Safe Grid Scale Energy Storage," $3,000,000 with $750,000 cost share (PI), October 1, 2023 – September 30, 2025 (Rejected)

National Science Foundation, Division of Materials Research, "MRI: Track #1 Acquisition of an Advanced Multi-Functional Wide Frequency and Wide Excitation Wavelength Range Raman Micro-Spectrometer for Materials Characterization," $731,347 (PI) September 1, 2023, August 31, 2026 (Rejected)

National Science Foundation, Division of Materials Research Ceramics Program, Supplement to "Convergence in Mixed Oxy-Sulfide-Nitride Glassy Solid Electrolytes: A Transformative and Enabling Complexity Towards Advanced Materials," $67,250, Proposal number 1936913, 8/1/2022 – 8/31/2023 (PI) (Rejected).

Department of Energy, "An Iowa State University-Sandia National Laboratories Collaborative Research Project: Engineering Solid Electrolyte-Anode and Solid Electrolyte-Cathode Interfaces in Solid State Batteries to Improve the Safety of Solid State Batteries," $750,000, October 1, 2022 – September 30, 2025 (PI) (Rejected).

National Science Foundation, Engineering Division, Chemical, Biological, and Environmental Technology Program, "Synthesis, Characterization, and Cell Performance of New Lithium Thio-OxyBorate Solid Electrolytes Guided by ab initio Computational Materials Discovery Techniques," $600,000, June 1, 2022– May 31, 2025 (PI) (Rejected).

Department of Energy, EPSCoR Implementation Grant, "Development and Testing of New All-Solid-State, Ultra-Safe, Ultra-Low-Cost, High-Energy-Density, Anode-Free Sodium Battery Systems for Grid-Scale Energy Storage, $2,999,999 with $750,000 cost share (PI)(Rejected)

National Science Foundation, Division of Materials Research, "Collaborative Research: DMREF: Predictive Design of Solid-State Electrolytes," $1,620,704, ISU Share $689,220, September 1, 2021 – August 31, 2025 (Co-PI)(Rejected)

National Science Foundation, Division of Civil, Mechanical, and Manufacturing Innovation, Future Manufacturing Program, "FMRGH: GOALI: Enabling Sustainable Glass Manufacturing through Integrated High-Throughput Ultrafast Synthesis, Simulations, and Machine Learning," $2,500,000, ISU Share $400,000, October 1, 2020 – September 30, 2025 (Co-PI) (Rejected)

Iowa State University, Presidential Interdisciplinary Research Seed-Grant, "Development of New All Solid State Ultra-Safe Low-Cost High-Energy Density Sodium Battery Systems for Grid Scale Energy Storage," $50,000, February 1, 2021 – January 31, 2022 (PI)(Rejected)

National Science Foundation, Division of Engineering, Chemical and Biological Engineering and Technology, Electrochemical Systems Program, "Preparation and Characterization of New Thin Film Mixed Oxy-Sulfide-Nitride Glassy Solid Electrolytes," $556,228, December 1, 2020 – Nov 30, 2023 (Rejected)

National Science Foundation, Division of Materials Research, "MRI: Acquisition of a Multi-Functional Multi-Material Wide-Wavelength-Range Fourier Transform Infrared Spectrometer for Materials Characterization - Track 1," $281,625 with $120,697 in Cost-Share (PI) July 1, 2020, June 30, 2024 (Rejected)

Iowa State University, 2017 Presidential Interdisciplinary Research Initiative, "Biosphere Energy Materials and Manufacturing Technologies (BEM2T)," $750,000, (PI) (Rejected) June 1, 2017 – May 31, 2020 Full Proposal

Iowa State University, College of Engineering, Grant Program Support for Developing Strategic Research Thrusts, "Transformative Research on All-Solid-State Sodium Batteries for Grid Scale Energy Storage," $75,000 January 1, 2015 - December 31, 2015 (Rejected) (PI).

National Science Foundation, Division of Materials Research, "Student-Based International Collaborative Research in Cooperation with the1st Joint Meeting of the US ACerS-GOMD and German DGG in Aachen Germany," $48,980, May 1, 2014 - April 30, 2015 (Rejected) (PI).

National Science Foundation, Division of Materials Research, "Iowa State University Materials Research Science and Engineering Center (ISU MRSEC)," $17,870,000, Pre-proposal, September 1, 2014 – August 31, 2020, (PI) (Rejected).

Defense Advanced Projects Agency, Department of Defense, "Distributed Substrate-Integrated Micro Batteries," $2,004,908, ($466,000 S. W. Martin share), August 1, 2013 – July 31, 2015, (Rejected) (co-PI)

Iowa State University, Presidential Initiative for Interdisciplinary Research, "BioSphere Energy Systems and Technologies (BEST)," $1,500,000, July 1, 2013 – June 30, 2016, (Rejected) (PI)

Air Force Research Laboratory, FOA-RQKS-2013-02, "Center of Excellence in Infrared Guided Wave Sources," $3,502,586, ISU share $600,000, May 1, 2013 – April 30, 2017 (subcontract from Clemson University) (co-PI) (Rejected).

U.S. Department of Energy, National Nuclear Security Administration, "Full Spectrum Neutron Detection System to Replace ^{3}He Detectors Using Novel Composite Hydrogenated Boron-Based Glasses," $750,000, 5/1/2012 – 4/30/2015, (Rejected) (PI)

National Science Foundation, Division of Materials Research, "Diametric Extremes in the Ionic Conductivity of Mixed Glass Former Solid Electrolytes," $698,662, 7/1/2012 – 6/30/2016, (rejected) (PI)

National Science Foundation, Division of Graduate Education, "IGERT: BioSphere Energy Systems and Technology (BEST) Training Group, $3,500,000, 7/1/2012 – 6/30/2017, (Rejected) (PI)

National Science Foundation, Division of Materials Research, "MRI: Acquisition of a Massively Parallel ElectroChemical Measurement System for Materials Education and Research in Renewable Energy Systems (MPECMS)," $525,000 with $225,000 ISU cost share, 8/1/2011 – 7/31/2013, (Rejected) (PI)

National Science Foundation, Division of Materials Research, "Materials World Network: An International Educational and Research Program In the Study of the Origins of Mixed Glass Former Effect," $1,745,840 August 1, 2011 – July 31, 2015 (Rejected) (PI, Co-PI R. Dieckmann, Cornell University, Co-PI S. Feller, Coe College, Co-PI M. Affatigato, Coe College)

DOE-EPSCoR, "Advancing Research Competitiveness in Iowa: Energy Storage Research - Preparation and Characterization of Electrochemically Stable Lithium Thio-oxynitride Thin Films for Use in High Energy Density Lithium Batteries for Storage and Transportation," $600,000, October 1, 2010 - September 31, 2013 (Rejected) (PI).

National Science Foundation, Division of Materials Research, "REU Site: Non-Equilibrium Materials (NEMat) Education and Research on Far-From-Equilibrium Materials, Structures, Properties, and Processing," $1,179,629, April 1, 2011 – March 31, 2016 (Rejected) (PI, Co-PI S. Beckman)

National Science Foundation, Integrative Graduate Education and Research Training program, "BEST IGERT: Biosphere Energy Systems and Technology," Pre-proposal, (PI) with M. Jefferies-El, K. Constant, A. Mann, V. Dalal (Rejected)

Department of Energy, ARPA-E "Rapid Very Low Cost Aerospray Formation of New Safe, High Capacity High Reversibility Room Temperature Sodium Batteries for Grid-Scalable Energy Storage," $1,502,709, (PI) with X. Tan, S. Beckman, Z. lin (Rejected)

Iowa State University, Bailey Award, "Development of New Lithium Thio-Oxynitridephosphate Solid Electrolytes for Safe, Low Cost, High Energy Density Solid State Batteries for Energy Storage," $150,000, July 1, 2010 – June 30, 2013, (Rejected) (PI).

NASA-EPSCoR, "AMES: Advanced Materials for Energy Storage - New Safe, High Rate, High Capacity Materials for Next Generation Lithium Batteries for Space Exploration," $742,125, August 1, 2010-July 31, 2013. (Rejected) (PI) Co-PI S. Beckman.

National Science Foundation, Division of Materials Research, "Materials World Network: An International Education and Research Program in the Use of the Mixed Glass Former Effect to Study Ion Conductivity in Solid Electrolytes," $2,055,152, October 1, 2010 – September 30, 2014, (Rejected) (PI)

DOE-EERE Golden Field Office, Lab Call #09-002 America Recovery and Reinvestment Act, Facilities and Equipment Upgrade, Creation of an Advanced Batteries Research and Development Facility at the Ames Laboratory" $13,670,000 (Rejected)(PI) Co-PIs J. O'Donnell, I. Anderson, M. Kramer, and A. Hillier.

Fiscal Year 2007 ISU Federal Agenda Book Proposal Initiative, "Federal Initiative Project: Advanced Composite Materials Program (ACMP)," October 1, 2007 – September 30, 2011, "$6,640,000 (Rejected) (co-PI with Derrick Rollins, Bruce Thompson and Erich Cochran (CBE), and Michael Kessler and Zhiqun Lin (MSE)).

Air Force Office of Scientific Research, Phase II SBIR Proposal No. TP-200727, AF Proposal No. F2-4044With Spire Corporation, Naval Research Laboratory, and Clemson University, "New, Mid-IR Rare Earth Chalcogenide Glass Fiber Laser," August 1, 2008 – July 31, 2010, $750,000, $200,000 ISU share (Rejected).

National Science Foundation, Division of Materials Research, Materials World Network Program, "Materials World Network in Optical and Electrical Field-responsive Materials: Engineered Material Properties and Performance," July 1, 2007 – June 30, 2011, $1,087,096, (rejected) (co-PI with Laeticia Petit and Kathleen Richardson, Clemson University).

Fiscal Year 2007 ISU Federal Agenda Book Proposal Initiative, "Fuel Cell Innovation Center (FCIC)," October 1, 2007 – September 30, 2011, $8,000,000, (Rejected) (PI)

The Lead Acid Battery Consortium, "Development of a Chemical, Structural, and Electro-Chemical Design and Analysis Tool for Advanced Electrode Grids for High-Rate Partial-State-of-Charge Lead-Acid Batteries," $261,283, May 1, 2007 – April 30, 2008, (PI, Co-PI T. Shih, AeroE) (Rejected)

National Science Foundation, Partnership for Innovation Program, "A Partnership for Innovation in Ceramic Membrane Fuel Cells," April 1, 2007 – March 30, 2010, $600,000 (PI) (rejected).

Mettler Toledo Thermal Analysis Education Grant, "Acquisition of a DMA/SDTA861e system," $135,000, July 1, 2006- June 30, 2007 (Co-PI with M. Kessler) (Rejected)

Edward Orton Jr. Ceramic Foundation, "Ultrasound Measurements of Viscosity," July 1, 2006 – June 30, 2007, $60,000 (Rejected) (PI, with D. Utrata, F. Margetan)

Iowa State University, Bailey Research Career Development Award, "Development of High Capacity NanoComposite Sulfide Glass Anodes for Lithium Batteries," July 1, 2006 – June 30, 2009 $150,000 (PI) (Rejected).

National Science Foundation, Division of Engineering, "Developing Extreme-Wind Loading Criteria and Strength Properties of Glass Cladding for a Safer and More Durable Building Envelope," May 6, 2006 – May 5, 2009, $405,878 (co-PI with Sarkar Partha and Frederick Hann (AEEM)) (Rejected).

"Development of High Temperature, Low Relative Humidity Proton Conducting Membranes," Department of Energy, Golden Field Office, Solicitation DE-PS36-05GO95020, $1,056,530 with $264,131 ISU cost sharing, January 1, 2006 – December 31, 2010 (PI) (Rejected).

National Science Foundation, Division of Materials Research, "Materials World Network: An International Collaborative Research Program in the Study of Excess Wing Relaxation Phenomena in Materials," May 1, 2006 – April 30, 2010, $1,280,000, (PI) (Rejected)

"Ceramic Membrane Fuel Cells (CMFCs) -Towards Zero-Emission Transportation Using Bio-Renewable Fuels: A Partnership for Innovation between ISU, Ames Laboratory, and the State of Iowa," National Science Foundation Partnerships for Innovation Program, October 1, 2005 – September 30, 2008, $600,000 (PI) (Rejected)

National Science Foundation, Division of Engineering, "Developing Extreme-Wind Loading Criteria and Strength Properties of Glass Cladding for a Safer and More Durable Building Envelope," August 16, 2005 – August 15, 2008, $401,480 (co-PI with Sarkar Partha and Frederick Hann (AEEM)), (Rejected).

Mettler Toledo Thermal Analysis Education Grant, "Acquisition of a DMA/SDTA861e system," $135,000, July 1, 2005- June 30, 2006 (Co-PI with M. Kessler) (Rejected)

ISIS Facility, Rutherford Appleton Laboratory, Experiment Proposal, "Structure of Proton Conducting Hydrated Alkali Thio-Hydroxogermanates," Sandals/GEM instrument for 5 days, Experiment number 520302, June 1 – August 31, 2005, (co-PI with Alexandar Matic, Chalmers University, Gothenburg, Sweden) (Rejected).

National Science Foundation, IMR-DMR "Acquisition of a Wide Frequency, Temperature and Impedance Range Impedance Spectrometer for Materials Education and Research," February 16, 2005, $246,735 (PI) (Rejected).

Department of Energy, National Energy Technology Laboratory, "Development of the Next Generation Materials for Improved Fuel Cell Membranes and Non-Contact Sensors for Distributed Energy Systems," July 1, 2005 – June 30, 2008, $1,515,000, (PI with Bill McCallum) (Rejected).

Iowa State University, Bailey Research Career Development Award, "Development of Ceramic Membrane-Based Proton Exchange Membrane Fuel Cells for Advanced Power and Transportation Applications Using Bio-Renewable Fuels, " July 1, 2005 – June 30, 2008 $150,000 (PI) (Rejected).

ISU Internal Competition – Funding for Research Equipment, Office of the Vice-Provost for Research, "Development of a Midwest Regional Electrochemical Impedance Spectroscopy Facility in the Department of Materials Science and Engineering," May 1, 2005 – April 30, 2006, $125,777 (PI with 12 others) (Rejected).

W. M. Keck Foundation, "Development of a Laboratory for Multi-Functional Materials Research," August 1, 2005 – July 31, 2009, $2,325,186 (PI with 4 Co-PIs) (Pre-proposal) (Rejected)

Ames Laboratory, Materials Chemistry Program, Department of Chemistry, "Fundamental Studies of a New Class of Thio-hydroxometallate Proton Conducting Ceramic Membranes for Next Generation Proton Exchange Membrane (PEM) Fuel Cells," (PI) (White paper)

National Aerospace Agency, John H. Glenn Research Center, "Development of Chemically and Thermally Robust Lithium Fast Ion Conducting Chalcogenide Glasses," March 1, 2005 – February 28, 2006, $100,698 (PI) (Rejected).

National Science Foundation, Division of Materials Research, "First Ever Separate and Independent Measurement of the Charge Carrier Number Density in FIC Electrolytes," $514,807 May 1, 2005 – April 30, 2009. (PI) (Rejected)

DOD DURIP 2005, "Acquisition of a Wide Frequency and Wide Temperature Range Dielectric/Impedance Spectrometer," $235,629, April 1, 2005 – March 30, 2006, (Co-PI) (Rejected)

ISU Foreign Travel Grant " Attendance at Smogen Summer School on Fuel Cells and 12th International Conference on Solid State Proton Conductors, Uppsala, Sweden, $810, 8/30/2004 (PI) (Rejected)

Iowa State University, "Development of Ceramic Membrane-Based Next Generation Proton Exchange Membrane Fuel Cells for Advanced Power and Transportation Applications Using Bio-Renewable Fuels," July 1, 2004 – June 30, 2007, $150,000 (PI) (Rejected).

National Science Foundation, Division of Materials Research, "First Ever Separate and Independent Measurements of the Charge Carrier Number and Ionic Mobility in FIC Electrolytes: Towards Overcoming the Maximum Conductivity in the Solid State," $841,516, 10/01/04 – 9/30/08, (PI) (Rejected)

The Department of Defense, Defense University Research Instrumentation Program, "Acquisition of a Wide Frequency and Wide Temperature Range Impedance Spectrometer," May 1, 2004 – April 30, 2005, $157,788 (PI) (Rejected)

Institute for Physical Research and Technology, Ames Laboratory, Research Seed-Funding Program 2004, "Development of Thin Film Chemical Solution Deposition Facility," October 1, 2003 – September 30, 2004, $40,000 (Co-PI) with David Cann (PI), Brian Gleeson, Eugene Zubarev, Vladimir Tsukruk, Xiaoli Tan (Rejected).

Office of Energy Efficiency and Renewable Energy, Golden Field Office, Solicitation DE-PS-36-03GO093007, "Development of New Fast Proton Conducting High Temperature Ceramic Membranes for Hydrogen Separation and Purification," October 1, 2004 – September 30, 2007, $537,819 with ISU Cost Share $134,455 (PI) (Pre-proposal) (Rejected).

Advanced Electron Beam, Inc., "Subcontract to ISU on "Using Ceramic Proton Conducting Membranes with Electron Beams to Produce Hydrogen," Office of Energy Efficiency and Renewable Energy, Golden Field Office, Solicitation DE-PS-36-03GO093007, October 1, 2003 – September 30, 2007, $1,760,000 (total) $400,000 (ISU), (Co-PI)(Pre-proposal)(Rejected).

Department of Energy, Hydrogen, Fuel Cells and Infrastructure Program though Los Alamos National Laboratory, "Development of New Fast Proton Conducting High Temperature Ceramic Membranes for Proton Exchange Membrane Fuel Cells," $218,993, January 1, 2004 – December 31, 2005, (PI) (Rejected).

Office of Naval Research, "Development of New Fast Proton Conducting Chalcogenide Electrolytes for a new Class of Proton Exchange Membrane Fuel Cells," $457,892, 10/1/2003 to 9/30/2006 (PI) (Pending).

National Science Foundation, Division of Materials Research, Ceramics Program, "Structure and Dynamics of Fast Ion Conducting Disordered Complex Materials: What is the Origin of Maximum Conductivity in the Solid State," Nov. 1, 2003 – Sept. 30, 2007, $797,706 (PI) (Rejected).

New Energy and Technology Development Organization (Japan), "Nano-phase separation in chalcogenides, and transient and permanent photo-induced phenomena," $612,245, October 1, 2004 – September 30, 2007, International Collaboration between University of Arizona (Nasser Peyghambarian), National Institute of Advanced Industrials Science and Technology (Kohei Kodono) and National Institute of Advanced Industrials Science and Technology (Tomoko Akai) (PI) (Rejected).

United Technologies Corporation, "Subcontract to ISU on 'Research and Development on Fuel Cells for Stationary Power and Automotive Applications," $600,000, 1/1/2004 – 12/31/2006, (PI) This subcontract is a part of a larger Cooperative Agreement Proposal by United Technologies with the Department of Energy through DOE solicitation DE-SC02-03CH11137, "Research and Development on Fuel Cells for Stationary Power and Automotive Applications," $4,600,000, 1/1/2004 – 12/31/2006, (N. Cipollini, UTRC, PI) (rejected)

Army Research Office, "Synthesis of New High Performance Thioborate Non-Linear Crystals for Use as Mid-Infrared Laser Sources for Application in Defense Communications and Countermeasures," $181,477 7/1/'03 – 6/30/'04 Co-PI with John Ballato, Clemson University, Shiv Halayasamani, University of Houston (Rejected).

Iowa State University, Carver Trust Grants, "RF Magnetron Sputtering of Highly Conducting Lithium Thionitride and thio-oxynitride thin films for lithium battery applications: A Multi-National and Industrial Collaboration Project," $25,000, 7/1/03 – 6/30/04, (Co-PI with Alan Constant) (Rejected)

Iowa State University, "Developing the Optical Sciences and Engineering at ISU: Synthesis of New High Performance Thioborate Non-Linear Crystals for Use as Mid-Infrared Laser Sources for Application in Communications and Industry," $150,000, June 1, 2003 – June 30, 2006 (PI) (Rejected)

National Science Foundation, Division of Materials Research, "Structure and Dynamics in Fast Ion Conducting Disordered Complex Materials: What is the Origin of the Maximum Conductivity in the Solid State?" July 1, 2003 - June 30, 2007, $737,920 (PI) (Rejected).

Iowa State University, Foreign Travel Grant, "Lectures and Collaborations in Korea," $3,000, 5/1/03 – 4/30'04 (Rejected) (PI).

Giner Electrochemical LLC, "Design and Development of Intermediate Temperature Ceramic Proton Conducting Membranes for H_2-O_2 fuel cells," Sub-contract on Army Research Office Small Business Technology Transfer (STTR) project, October 1, 2002 – March 30, 2003, $35,827, (PI)

Associated Glass and Pottery Manufactures Association, "Scholarship and Grant Support for Undergraduate and Graduate Students in the Field of Glass Science & Engineering: Enabling the Linkage between the Glass Industry and Universities," August 1, 2002– July 31, 2003 $19,840 with $8,500 ISU cost share, (Rejected) (PI)

Iowa State University, Center for Non-Destructive Evaluation, "Photostructurable Glasses: A Model System of Self-Healing Adaptive Materials," July 1, 2002 – June 30, 2003, $64,800, (PI) (Rejected)

National Science Foundation, Division of Materials Research, "US and EU Multi-National Collaboration on Ionic Motion in Disordered Materials: Towards a Unified Theory and New Optimized Materials for Next Generation Electric Power Sources," $588,446, 1/15/01 – 1/14/03 (PI) (Rejected)

National Science Foundation, Division of Materials Research, Instrumentation for Materials Research Program, "Acquisition of a Comprehensive FT-IR Spectrometer and Scanning Probe Microscope System for Materials Education and Research," October 1, 2001 – September, 30, 2002, $245,000 with $105,000 ISU match (PI, with V. Tsukuruk, Co-PI) (rejected).

Iowa State University, Center for Teaching Excellence, Miller Faculty Fellowship, "Strengthening the Undergraduate Academic Curriculum in Materials Science & Engineering by Developing A New Programmatic Connection Between Materials Processing Education and Industrial Practice in Process Control," $15,000, 7/1/01 – 6/30/02 (PI) (rejected)

Iowa State University Foreign Travel Grant, "Travel to Japan, Korea, and China for Research Collaboration and Seminars on Glass," June, 2001, $3,000 (rejected).

National Aerospace Agency, John H.Glenn Research Center "Development of Chemically and Thermally Robust Lithium Fast Ion Conducting Chalcogenide Glasses," September 1, 2000 – August 21, 2001, $99,760, with $13,349 ISU cost share, (PI) (rejected)

National Science Foundation, Division of Materials Research, Instrumentation for Materials Research Program, "Acquisition and Development of a Comprehensive FT-IR Spectrometer Scanning Probe Microscope and Micro Thermal-Mechanical Analyzer," June 1, 2000 – May 31, 2003 (rejected), $461,772 with $165,000 ISU match (PI, with V. Tsukuruk, Co-PI).

Department of Defense, University Research Instrumentation Program "Acquisition of a Comprehensive Electrochemical Characterization System," $76,070, 3/31/2000 – 4/1/2001 (PI) (rejected)

Raytheon Systems, Inc., "Thermophysical Property Measurements of IR Transmitting Chalcogenide Glasses," $50,000, 5/1/'99 - 4/30/'00 (PI) (rejected)

Center for Advanced Technology Development, " Development of Low Cost Low Tg Phosphate Glasses as Hosts for Organic Molecule-Based Opto-Electronic Devices and Systems," Collaboration with Professor Joshua Otaigbe (ISU) and Dr. Paul Tick (Corning, Inc.), $29,354, April 1, 1998 - June 31, 1999 (PI) (Rejected)

National Science Foundation, Division of Materials Research, "Dynamics and Structure of New Chalcogenide Glasses: Towards a Universal Treatment of Dynamic Processes In Glass", $677,050, 5/1/'98 - 4/31/'03, (PI) (Rejected)

Department of Energy, Office of Industrial Technology, Glass Industry of the Future Initiative, "Co-operative Research Agreement with Industry to Develop Low Cost Low Tg Glasses for Polymer Composite and Novel Optical Materials", $955,000, 1/1/'98 - 12/31/'01(Co-PI)(Rejected)

National Science Foundation, Division of Materials Research, "New fast scintillating radiation hard glass as detectors in high energy physics and medical imaging," $396,674, 10/1/95 - 9/31/96, (Co-PI) (Rejected).

National Science Foundation, Division of Physics, "New fast scintillating radiation hard glass as detectors in high energy physics and medical imaging," $396,674, 10/1/95 - 9/31/96, (Co-PI) (Rejected).

Motorola Corporation, University Research Program, $50,000, 9/1/95-8/31/95. (PI) (Rejected)

National Science Foundation, Division of Materials Research, "An undergraduate research program at ISU, Coe College, and Grinnell College," $1,000,000, 10/1/95 - 9/30/98. (Co-PI)(rejected)

Department of Defense, Advanced Research Projects Agency, "Development of new faster for conducting chalcogenide glasses as new solid electrolytes," ISU sub-contract, $85,000, 1/31/95 - 12/31/96, (Co-PI) (rejected).

National Institute of Standards and Technology, Advanced Technology Program, "New laser optical fibers for laser surgery," $2,000,000, 1/1/95 - 12/31/98, (rejected), (PI).

National Science foundation, Division of Materials Research, Advanced Materials Processing Program, "New fast scintillating radiation hard glasses as detectors in high energy physics and medical imaging," 1,200,000, 10/31/94 - 9/31/97, (rejected), (Co-PI).
General Electric Foundation, "Faculty of the future program at ISU, $1,000,000 with ISU match, 10/1/94 - 9/31/99, (rejected), (PI).

National Science Foundation, Division of Manufacturing and Technology, "Development of next generation laser optical fibers for use with Nd:YAG laser systems in surgical applications," $675,000, 10/1/94 - 9/31/97, (rejected), (PI).

National Science Foundation, Division of Materials Research, "Acquisition of FT-Raman spectrometer," $120,000 with $60,000 ISU match, 10/1/94 - 9/31/95, (rejected), (PI).

National Science Foundation, "Development of a new undergraduate laboratory methodology: Real time fast scanning x-ray diffractometry," $160,000 with $80,000 ISU match, 10/1/94 - 9/30/95, (rejected), (Co-PI).

Lawrence Berkeley Laboratory, "Preparation and Characterization of New Divalent Cation Fast Ion Conducting Chalcogenide Glasses as New Solid Electrolytes," $132,000, 10/1/93-9/30/94 (rejected), (PI).

National Technology Transfer Center, "A Technology Partnership for the Development of New Laser Optical Fibers for Laser Surgery," $132,750, 6/1/93-5/31/95 (rejected) (PI).

Texas National Research Laboratory Commission, "Development of new, fast scintillating, high-density glasses for the superconducting supercollider," $777,175, 4/1/93 - 3/31/96, (Rejected), (PI).

Motorola, Inc., "Development of high conductivity glasses and glass and polymer composites as electrolytes for use in new high energy density rechargeable lithium and sodium cells," $477,863, 1/1/93 - 1/1/95 (rejected), (PI).

National Science Foundation, "Development of a new undergraduate laboratory methodology: Real-time fast scanning x-ray diffractometry," $177,960 (includes $88,980 non-NSF contribution), submitted 11/16/92 (rejected), (Co-PI).

National Science Foundation, "Renovation of Research Facilities in Materials Science and Engineering," $550,000, 11/1/92 - 10/31/93 (Rejected), (Investigator).

National Institutes of Health, "Laser Optical Fibers for Use with Nd:YAG Laser Systems." $644,530, 10/1/92 - 9/30/95 (Rejected), (PI).

National Science Foundation, "Development of next generation laser optical fibers for use with Nd:YAG laser systems in surgical applications," $526,149, 10/1/92 - 9/30/95 (Rejected), (PI).

National Science Foundation, REG Program, "Engineering Research Equipment: Acquisition of Optical Fiber Drawing Tower," $150,000, 10/1/92 - 9/30/94 (Rejected), (PI).

Iowa State University, "Project Vincent 1992: Proposal for the Acquisition DS5000/125 Workstations," (Rejected), (PI).

Institute for Physical Research & Technology, ISU, "Acquisition of a high quality laser optical fiber drawing tower," $250,000, 10/1/92 - 9/30/93 (Rejected), (PI).

Whittaker Foundation, "Development of next generation laser optical fiber for use with Nd:YAG laser in surgery application," $180,000, 10/1/91 - 9/30/94 (rejected).

National Science Foundation, Materials Chemistry Initiative, "Novel atrane polymers and monomers," $503,097, 6/1/91 - 5/31/94, Co-Investigator with John Verkade in Chemistry (Rejected), (Co-PI).

National Science Foundation, Materials Research Group Program, "Metal oxide and sulfide thin-films by plasma-enhanced organometallic chemical vapor deposition," $1,963,597, 6/1/91-5/31/94. Co-investigator with Glenn Schrader and five other Chemical Engineering Faculty (Rejected).

National Science Foundation, Instrumentation and Laboratory Improvement Program, "Development of a new undergraduate laboratory methodology: Interactive PC-based scanning electron microscopy," $98,775 - with matching from ISU, 5/1/91 - 4/30/93 (Rejected), (Co-Investigator with Scott Chumbley, John Verhoeven and Mufit Akinc).

National Science Foundation, Division of Materials Research, "New atrane systems: Polymeric and MOCVD ceramic precursors," $503,097, 1/1/91 - 12/31/93 (Rejected), (Co-Investigator with John Verkade and David Martin).

Iowa State University, University Grants Program, "Development of new laser optical fibers for use with Nd:YAG laser systems in surgical applications," $15,000, 1/1/91 - 12/31/91 (Rejected), (PI).

Alfred P. Sloan Research Fellowship, Alfred P. Sloan Foundation, $25,000, 9/l/90 - 7/3l/91 (PI) (Rejected).

Air Force Office of Scientific Research, "Synthesis of new atrane systems: Thermally stable liquid and solid polymers, polymeric ceramic precursors, MOCVD agents and NLO materials," $752,815, 7/20/90 - 7/19/93 (Rejected), (Co-Investigator with John Verkade and David Martin).

Air Force Office of Scientific Research, DOD University Research Initiation Program, "Preparation and characterization of new high temperature 8-14μm IR transmitting chalcogenide glasses," $337,315, 2/1/90 - 1/31/93 (PI) (Rejected).

Office of Naval Research, "Preparation and characterization of new high-temperature 8-14 μm IR transmitting chalcogenide glasses," $349,165, 10/1/89 - 9/31/92 (Rejected).

Department of Energy, "Proposal to search for dense rare earth scintillators for use at the SSC," $136,800, 9/1/89 - 8/31/90 (Rejected).

National Science Foundation, Presidential Young Investigator, $25,000/year with renewal up to five years total, 1/1/89 - 12/31/90 (Rejected).

Air Force Office of Scientific Research, "Preparation and Characterization of New High Temperature 8-14 μm IR Transmitting Chalcogenide Glasses," $205,060, 10/1/88 - 9/31/91 (Rejected).

Office of Naval Research, "Preparation and Characterization of New High Temperature 8-14μm IR Transmitting Chalcogenide Glasses," $193,140, 6/1/88 - 5/31/91 (Rejected).

Department of Energy, "Preparation and Characterization of New Superionically Conducting Chalcogenide Glasses," $64,465, 11/1/87 - 10/31/88 (Rejected).

Office of Naval Research, "Preparation and Characterization of New Chalcogenide Glasses," $256,000, 6/1/87 - 5/31/90 (Rejected).

Army Research Office, "Preparation and Characterization of New Superionically Conducting Chalcogenide Glassy Solid Electrolytes," $250,000, 6/1/87 - 5/31/90 (Rejected).

Sigma Xi Research Grant, Sigma Xi Foundation, "Preparation of New Chalcogenide Glasses," $900, 1/1/87 - 12/31/88 (Rejected).

Aluminum Company of America, "Al_2S_3-based Glassy Solid Electrolytes," $35,000, 1/1/87 - 12/31/87 (Rejected).

Minnesota Mining and Manufacturing Company, Research Initiation Grants for Non-Tenured Faculty, $10,000/year up to the year of awarding tenure, 1/1/87 - 12/31/87 (Rejected)

Hewlett-Packard Company, "The Acquisition of an HP-4194 Impedance Analyzer," $20,000, 1/1/87 - 12/31/87 (Rejected).

VIII. TECHNICAL PUBLICATIONS

Refereed Journal and Proceeding Articles:

239. "Carbon-coated Sn nanoparticles for high capacity anodes in lithium ion batteries," Emma M. H. Whitea, Lisa M. Rueschhoff, Steve W. Martin, Iver E. Anderson, Batteries
Manuscript ID, batteries-3237316, Submitted September 16, 2024.

238. "One-step spark plasma erosion processing of carbon-coated Sn-Si nanoparticles for lithium ion battery anodes," Emma Marie Hamilton White *, Lisa Rueschhoff, Takeshi Kobayashi, Jonathan Bloh, Steve Martin, Iver Anderson ,Manuscript ID: surfaces-3109761, submitted July 1, 2024.

237. "Shear strength and optical energy gap in As2Se3 glasses permanently compacted under GPa pressures," Giovanna D'Angelo, Gaetano Di Marco, Mauro Federico, Valentino Romano, Steve Martin, Inseok Seo, Journal of Non-Crystalline Solids, Manuscript ID: NOC-D-24-00739, Submitted June 2024.

236. "Flexible Doorway Controlled Na+ Ion Diffusion in NaPSO Glassy Electrolytes from Machine-Learning Force Field Simulations," Kun Luo, Rui Zhou, Steve W. Martin, and Qi An, Journal of the American Chemical Society Manuscript ID: ja-2024-08947e, Submitted July 2, 2024.

235. "Impact of impurities on the thermal properties of a Li2S–SiS2–LiPO3 glass," Jacob Wheaton, Steve W. Martin, SPECIAL ISSUE ARTICLE, International Journal of Applied Glass Science, Vol.15, No.3, PPs. 317-328, 2024, https://doi.org/10.1111/ijag.16654

234. "Formation of Stable Radicals by Mechanochemistry and Their Application for Magic Angle Spinning Dynamic Nuclear Polarization Solid-State NMR Spectroscopy," Scott L. Carnahan, Kipper Riemersma, Ihor Z. Hlova, Oleksandr Dolotko, Steven J. Kmiec, Sujeewa N. S. Lamahewage, Steve W. Martin, James F. Wishart, Thierry Dubroca, Viktor P. Balema, and Aaron J. Rossini, Journal of Physical Chemistry A 2024, Vol. 128, no.18, pps. 3635–3645, https://doi.org/10.1021/acs.jpca.4c00228

233. "Ionic Conductivity of and Structure and Property Relationships in $L_{i2}S + SiS_2 + LiPO_3$ Glassy Solid Electrolytes," Victor Torres III, Presley Philipp, Steven Kmiec, Steve W. Martin, Chemistry of Materials, Vol. 36, No. 11, pps. 5521–5533, 2024, https://doi.org/10.1021/acs.chemmater.4c00464

232. "Structure and Properties of Na_2S-SiS_2-P_2S_5-$NaPO_3$ Glassy Solid Electrolytes
Madison Olson, Steven Kmiec, Kyler Krupp, Noah Riley, Nicholas Oldham, Arumugam Manthiram and Steve W. Martin, Inorganic Chemistry, 2024, Vol. 63, no. 20, pps. 9129–9144, https://doi.org/10.1021/acs.inorgchem.4c00423.

231. "Insights into Lithium Sulfide Glass Electrolyte Structures and Ionic Conductivity via Machine Learning Force Field Simulations," Zhou, Rui; Luo, Kun; Martin, Steve; An, Qi, American Chemical Society: Applied Materials & Interfaces, Vol. 16, no. 15, pps. 18874–18887, 2024, https://doi.org/10.1021/acsami.4c00618

230. "Converting a Commercial Separator into a Thin-film Multi-Layer Hybrid Solid Electrolyte for Li Metal Batteries," Peter Maria Bieker; Lukas Herbers; William Fettkether; Silvian Stuckenberg; Debbie Bergus; Steve W. Martin; Martin Winter, Batteries & Supercaps, Vol. 7, No. 3, pps. e202300478 (1-14), 2024 https://doi.org/10.1002/batt.202300478

229. "Glassy solid-state electrolytes for all-solid state batteries," Jacob Wheaton, Madison Olson, Victor M. Torres III, and Steve W. Martin, Cover Story, Bulletin of the American Ceramic Society, Vol. 102, no. 1, pps. 24-31, 2023
https://ceramics.org/wp-content/uploads/2022/12/JanFeb-2023_Feature.pdf

228. "Short Range Order Structures of Lithium Oxy-ThioSilicate Glasses," Guantai Hu, Victor M. Torres III, Steve W. Martin, Journal of Non-Crystalline Solids: X, Vol. 19, pp. 100198, 2023
https://doi.org/10.1016/j.nocx.2023.100198

227. "The Novel Oxy-sulfide Glassy Ionic Conductors $Na_4P_2S_{7-x}O_x$ $0 \leq x \leq 7$: Understanding the Features of Static and Dynamic Cations," Ananda Shastri, Nathan Rons, Qing-Ping Ding, Steven J. Kmiec, Madison Olson, Yuji Furukawa, Steve W. Martin, Solid State Ionics, Vol. 402, pp. 116363, 2023, https://doi.org/10.1016/j.ssi.2023.116363

226. "$Li_{1.4}Al_{0.4}Ti_{1.6}(PO_4)_3$ Inorganic Solid Electrolyte for All-Solid-State Li - CO_2 Batteries with MWCNT and Ru nanoparticle catalysts," Dan Na, Roopa Kishore, Kampara, Dohyeon Yu, Baeksang Yoon, Steve W. Martin, Inseok Seo, Materials Today Energy, Vol. 38, pp. 101418, 2023, https://doi.org/10.1016/j.mtener.2023.101418

225. "Structure-mechanical properties correlation in bulk LiPON glass produced by nitridation of metaphosphate melts," Victor M. Torres III, Sergiy Kalnaus, Steve W. Martin, Caitlin Duggan, Andrew S. Westover, Journal of the American Ceramic Society, Vol.106, No. 11, pps.6565-6576, 2023, http://doi.org/10.1111/jace.19327.

224. "Critical Role of Pressure for Chemo-Mechanical Induced Stability of Sodium Metal Battery Anodes," Jiao, Weimin; Zohair, Murtaza; Eaves-Rathert, Janna; Ramamurthy, Jayanth; Harkaway, Andrew; Mort, Rebecca; Wheaton, Jacob; Jiang, Shan; Martin, Steve; Pint, Cary, American Chemical Society Energy Letters, American Chemical Society Energy Letters, Vol. 8, No. 6, pps. 2711–2717, 2023, https://doi.org/10.1021/acsenergylett.3c00734.

223. "Optimized thin film processing of sodium mixed oxy-sulfide-nitride glassy solid electrolytes for all-solid-state batteries," Madison Olson, Jacob Wheaton, Mary Okkema, Nicholas Oldham, Steve W. Martin, , ACS Applied Energy Materials, American Chemical Society Applied Energy Materials, Vol. 6, No. 11, pps. 5842 – 5855, 2023, https://doi.org/10.1021/acsaem.3c00294.

222. "Effects of LiPON Incorporation on the Structures and Properties of Mixed Oxy-Sulfide-Nitride Glassy Solid Electrolytes," Victor Torres, III, Steve W. Martin, Inorganic Chemistry, Vol. 62, pps. 8271−8284, 2023. https://doi.org/10.1021/acs.inorgchem.3c00756

221. "Medium Range Ordering in the Ionic Glass Electrolytes LiPON and LiSiPON," Andrew Westover, Mordechai Kornbluth, Takeshi Egami, Jue Liu, Sergiy Kalnaus, Dong Ma, Andrew Kercher , Joerg Neuefeind, Michelle Everett, Boris Kozinsky, Victor Torres, Steve Martin, Nancy Dudney, Chemistry of Materials, Vol. 35, No. 7, pps. 2730 – 2739, 2023, https://doi.org/10.1021/acs.chemmater.2c02380

220. "NaPON doping of $Na_4P_2S_7$ glass and its effects on the structure and properties of mixed oxy-sulfide-nitride phosphate glass," Madison Olson, Steven Kmiec and Steve W. Martin, Inorganic Chemistry, Vol. 61, issue 44, pps. 17469 – 17484, 2022, https://pubs.acs.org/doi/10.1021/acs.inorgchem.2c02300

"Interpretation of the Na^+ Ionic Conductivity in $Na_4P_2S_{7-x}O_x$ Mixed Oxy-Sulfide (MOS) Glasses: Effects of Diverse Sodium Environments," Steven Kmiec, Madison Olson, Matthew Kenney, Steve W. Martin, Chemistry of Materials, Vol. 34, Issue 21, pps. 9479 – 9491, 2022, https://pubs.acs.org/doi/10.1021/acs.chemmater.2c01934

"Grain-Boundary-Free Glassy Solid Electrolytes based on Sulfide Materials: Effects of Oxygen and Nitrogen Doping on Electrochemical Performance," Ran Zhao, Guantai Hu, Steven Kmiec, Jacob Wheaton, and Steve W. Martin, Batteries and Supercapacitors, Vol. 5, Issue 11, pps. e2021000356-1-13, 2022, https://doi.org/10.1002/batt.202100356

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IX. TECHNICAL PRESENTATIONS

Scientific Meetings:

"On the structure and properties of new mixed glass former $Na_2S+GeS_2+PS_{5/2}$ Glassy Solid Electrolytes for Low Temperature All Solid State Sodium Batteries," International Symposium on Non-Oxide and New Optical Glasses, Jeju, Republic of Korea, August 2014

"Structure and Glass Relaxation Studies of Melt Quenched and Mechanically Milled $Na_2S + P_2S_5$ Glasses," with Maxwell Marple, Christian Bischoff, Katherine Schuller, Seth Berbano, 8th Annual Meeting on Borate Glasses, Melts, and Crystal, Pardubice, Czech Republic, June 2014.

"On the Role of Boron on the Structure and Properties of Mixed Glass Former Na^+ Ion Conducting $Na_2O + B_2O_3 + P_2O_5$ Glassy Solid Electrolytes" with Philipp Mass, Randilynn Christensen, Garrett Olson, Michael

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"On the Role of Boron on the Structure and Properties of Mixed Glass Former Na^+ Ion Conducting Na_2O + B_2O_3 + P_2O_5 Glassy Solid Electrolytes" with Philipp Mass, Randilynn Christensen, Garrett Olson, Michael Schuch, ChristianTrott, 1st Joint Meeting of the Glass and Optical Materials Division of the American Ceramic Society and the Germany Society of Glass Technology, Aachen, Germany, May 2014.

"Towards Higher Energy Density Lithium Batteries: Problems with Existing Systems and Opportunities for Future Research," Division of Materials Science and Engineering, Ames Laboratory, Iowa State University, October 2008.

"Mixed Glassformer Effects in Sodium alkali borophosphate and thioborophosphate Glasses," 6th International Conference on Borate Crystals, Glasses, and Melts, Himeji, Japan, August 2008.

"Ionic Conduction in Trivalent Doped Tetrahedral Networks: $MI+M_2S+[0.1Ga_2S_3+0.9GeS_2]$, M = Li, Na, K and Cs Glasses," Glass and Optical Materials Division Meeting of the American Ceramic Society, Tucson, AZ, May 2008

"DSC Studies of the Ion Conduction Glass Transition Temperature," S. W. Martin, 21st Annual Midwest University Conference on Glass, August 2, 2007.

"Space Charge Polarization in Ion Conducting Materials: A New Method to Determine the Number of Mobile Charges in FIC Electrolytes," 16th International Confernce on Solid State Ionics, Shanghai, China, July 2007.

"Fiber Bragg Grating in As_2S_3 Chlacogenide Glass Optical Fibers," H. Y. Yuen, B. Ferreira, S. W. Martin, Materials Science and Technology, ACerS Glass and Optical Materials Division Program, Cincinnati, OH, October 15-18, 2006 (with H.Y. Yuen)

"The Structure, Conductivity, and Space Charge Polarization in Li_2S + GeS_2 + GeO_2 Glasses," Materials Science and Technology, ACerS Glass and Optical Materials Division Program, Cincinnati, OH, October 15-18, 2006, with Wenlong Yao.

"The Structure of and Li^+- ion Conduction in Germanium Oxy-Sulfide Glasses," Glass and Optical Materials Division Spring Meeting of the American Ceramic Society, Greenville, SC, May 17-19, 2006

"X-ray and Neutron Diffraction Studies of Alkali Thioborate Glasses," Glass and Optical Materials Division Spring Meeting of the American Ceramic Society, Greenville, SC, May 17-19, 2006

"The Structure and Conductivity of Li_2S + GaS_3 + GeS_2 Glasses," Glass and Optical Materials Division Spring Meeting of the American Ceramic Society, Greenville, SC, May 17-19, 2006

"Enthalpy Relaxation Studies of the Bulk Metallic Glass Transition," 5th International Discussion Meeting on Relaxation in Complex Systems," Lille, France, July 7 – 12, 2005.

"Space Charge Polarization in Ion Conducting Materials: A New Method to Determine the Number of Mobile Charges in FIC Electrolytes." 15th International Meeting on Solid State Ionics, Baden-Baden, Germany, July 17 – 22, 2005.

"Alkali Thio-hydroxometallates A New Class of Intermediate Temperature Proton Conducting Ceramic Membranes," 15th International Meeting on Solid State Ionics, Baden-Baden, Germany, July 17 – 22, 2005.

"Fast Ion Conducting Glasses: Optimization Procedures for Next Generation Lithium Batteries," Department of Applied Physics, Chalmers University of Applied Physics, June 2, 2005.

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"Neutron Diffraction Study of Low Alkali Sodium Thioborate Glasses," W. L. Yao, Q. Mei, S. Martin, Joint Meeting of the Glass and Optical Materials Division of the American Ceramics Society and the International Conference on Non-Oxide Glasses, Orlando, FL, November 7-11, 2004

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"Synthesis and Characterization of a New Class of Ceramic Intermediate Temperature Proton Conducting Alkali Thiohydroxometallate Membranes for use in Proton Exchange Membrane Fuel Cells," 12th International Meeting on Solid State Proton Conductors, Uppsala, Sweden, August 16-19, 2004

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"Enthalpy Relaxation Measurements of the Bulk Metallic Glass Transition," 17th Univeristy Conference on Glass, Rennsealaer Polytechnic Institute, August 11-14, 2003

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"Structural Investigation of $Ag_2S + B_2S_3 + GeS_2$ Glasses Using Neutron Scattering", 105th Annual Meeting of the American Ceramic Society, Nashville, TN April, 2003, (with Qiang Mei)

"Trapping Model of the Non-Arrhenius Ionic Conductivity in FIC Glasses," 4th International Conference on Borate Melts, Crystals, and Glasses, Cedar Rapids IA, July 24-26, 2002

"Preparation and Characterization of Glasses in the $Ag_2S+B_2S_3+GeS_2$ System," 104th Annual Meeting of the American Ceramic Society, St. Louis, MO, April 2002 (with Qiang Mei, Jason Saienga, and Ben Meyer)
"Using Multiple Distributions in ^{7}Li NMR of FIC Ternary $Li_2S + B_2S_3 + GeS_2$ Glasses," 104th Annual Meeting of the American Ceramic Society, St. Louis, MO, April 2002 (with Ben Meyer, Qiang Mei, Jason Saienga, and Ferdinando Borsa)

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"Raman Spectroscopy of $Na_2S + B_2S_3$ Glasses and Polycrystals," S.W. Martin, Fall Meeting of the Glass and Optical Materials Division of the American Ceramic Society, Corning, NY, October 2000.

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"Neutron Diffraction Studies of the Intermediate Range Order in Vitreous Boron Trisulfide," 101st Annual Meeting of the American Ceramic Society, St. Louis, MO, April 2000 (with M.Royle, A. Wright)

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"Alkali Thioborate Glasses as Model Systems to Probe the Relationships Between Intermediate Range Order in Glass and Physical Properties," Fall Meeting of the Glass and Optical Materials Division of the American Ceramic Society, San Antonio, TX, Oct. 1996

"Structure and Properties of Heavy Alkali Thioborate Glasses," 98th Annual Meeting of the American Ceramic Society, Indianapolis, IN, April 1996.

"On the Interaction of Silica-based Laser Optical Fibers with Tissue", 13th University Conference on Glass, Troy, NY, August 1995

"Structure and Properties of Alkali Ultraphosphate Glasses", 13th University Conference on Glass, Troy, NY, August 1995

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"NMR Studies of Fast Ion Conducting Glasses Chalcogenide Glasses: Correlation of Conductivity and Nuclear Spin-Lattice Relaxation (NSLR) Measurements", 97th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 1995,

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"IR Spectroscopy Studies of the Structure of Alkali Thioborate Glasses", Fall Meeting of the Glass and Optical Materials Division of the American Ceramic Society, Columbus, OH, Nov. 1994

"Development of New ULE Laser Optical Fibers for Laser Surgery", 96th Annual Meeting of the American Ceramic Society, Indianapolis, IN, April 1994 (with A. Soufiane)

"Interaction of Silica Laser Optical Fibers with tissue during Laser Surgery", 96th Annual Meeting of the American Ceramic Society, Indianapolis, IN, April 1994 (with S. Grant)

"Fast Ion Conduction in New Silver Thioborosilicate Glasses: Non-Arrhenius Conductivity", 96th Annual Meeting of the American Ceramic Society, Indianapolis, IN, April 1994 (with J. Kincs)

"High Frequency Conductivity and Nuclear Spin Lattice Relaxation Time Measurements of Fast Ion Conducting Chalcogenide Glasses", 96th Annual Meeting of the American Ceramic Society, Indianapolis, IN, April 1994 (with H. Patel)

"Preparation and Characterization of New Heavy Metal Fluoride Glasses," 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993 (with W. Zhou).

"Preparation and Characterization of New Potassium Thioborate Glasses," 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993 (with J. Cho).

"^{11}B NMR Studies of Glasses in the Systems $Na_2S + B_2S_3$ and $K_2S + B_2S_3$ Glasses," 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993 (with J. Sills).

"Wide Frequency (1Hz - 1GHz) Conductivity Relaxation in the Na_2S - B_2S_3 Glass System," 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993 (with H. Patel).

"Ionic Conductivity Relations in the Na_2S - B_2S_3 Glass System," 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993 (with H. Patel).

"MD Simulation and Visualization of Fast Ion Dynamics in Sodium Silicate Glasses," 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993.

"^{29}Si MAS-NMR Study of the Short Range Order in Potassium Borosilicate Glasses," 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993 (with A. Bhatnagar).

"Wide Temperature Range Studies of the Heat Capacities of $xNa_2S + (1-x)B_2S_3$ Glasses," 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993.

"Preparation and Characterization of New High Density, Scintillating Glasses," 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993 (with S. E. Van Kirk).

"Densities of Several Heavy Metal Oxide Glass Systems," 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993 (with S. Bhowmik, A. Bhatnagar, V. Gosula, C. Parameswar, S. Messer, and S. Feller).

"Characterization of $PbO-GeO_2-Ga_2O_3-Bi_2O_3$ and $PbO-SiO_2-Ga_2O_3-Bi_2O_3$ Glass Systems," 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993 (with V. Gosula).

"The Structure and Properties of Anhydrous Sodium and Lithium Ultra-Phosphate Glasses," (invited paper), 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993 (with James J. Hudgens, K. Garrett, R. K. Brow, and David R. Tallant).

"The Nature of the Glassy State: Structure, Properties and Measurement," 1993 Student Physical Society Regional Conference, Coe College, Cedar Rapids, IA, April 9, 1993.

"Wide composition range study of non-exponential conductivity relaxation in fast ionically conducting $Na_2S + B_2S_3$ glasses,", 94th Annual Meeting of the American Ceramic Society, Minneapolis, MN, April 15, 1992.
"Multiple frequency spin lattice relaxation time measurements of the FIC glasses," 8th International Conference on Solid State Ionics, Banff, Canada, October 20-26, 1991.

"Fast ionic conduction in low alkali $Na_2S + B_2S_3$ glasses: Compositional contribution to non-exponentiality," 8th International Conference on Solid State Ionics, Banff, Canada, October 20-26, 1991.

"Preparation and characterization of new high density PbO + Bi_2O_3 + B_2O_3 glasses," Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 28-May 2, 1991.

"Glass transition temperature and heat capacity measurements of Na_2S + B_2S_3 glasses," Annual meeting of the American Ceramic Society, Cincinnati, OH, April 28-May 2, 1991.

"Preparation and characterization of new anhydrous Li_2O + P_2O_5 glasses," Annual meeting of the American Ceramic Society, Cincinnati, OH, April 28-May 2, 1991.

"Multiple frequency spin lattice relaxation time and conductivity measurements on the FIC glasses Li_2S + SiS_2," Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 28-May 2, 1991.

"Multiple frequency spin lattice relaxation time and conductivity measurements on the FIC glasses Li_2S + SiS_2, "Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 28-May 2, 1991.

"Structures and properties of glasses in the series xNa_2S+ (1-x) B_2S_3, "The Second International Ceramic Science and Technology Congress, Orlando, FL, November 12-15, 1990.

"Multiple-frequency spin-lattice relaxation time measurements on Li_2S + SiS_2 glasses," International Discussion Meeting on Relaxation in Complex Systems, Heraklion, Crete, Greece, June 18-29, 1990.

"Preparation and infrared characterization of compounds, polycrystals and glasses in the series xNa_2S + (1-x)B_2S_3, "Annual Meeting of the American Ceramic Society, Dallas, TX, April 22-26, 1990.

"Multiple-frequency spin-lattice relaxation time measurements of Li_2S + SiS_2 glasses," Annual Meeting of the American Ceramic Society, Dallas, TX, April 22-26, 1990.

"Preparation and characterization of new high Tg glasses in the BaS + $A1_2S_3$ + SiS_2 series," Fall Meeting of the Glass Division, American Ceramic Society, Orlando, FL, September 17-20, 1989.

"Multiple frequency spin lattice relaxation time measurements of fast ion conducting glasses," Fall Meeting of the Glass Division, American Ceramic Society, Orlando, FL, September 17-20, 1989.

"On the preparation and properties of vitreous B_2S_3," Fall Meeting of the Glass Division, American Ceramic Society, Orlando, FL, September 17-20, 1989.

"A neutron diffraction study of network glasses with a structural unit connectivity of three," Fall Meeting of Glass Division, American Ceramic Society, Orlando, FL, September 17-20, 1989 (presented by Austen C. Angell).

"Multiple frequency T_1 measurements of fast ion conducting glasses," Gordon Conference on Solid State Ionics, Proctor Academy, Andover, NH, July 24-28, 1989.

"Preparation and characterization of new ultra-high Tg 8-14 μm transparent chalcogenide glasses," Annual Meeting of the American Ceramic Society, Indianapolis, IN, April 23-27, 1989.

"Glass transition temperature and infrared spectroscopy of lithium thioborate glasses," Annual Meeting of the American Ceramic Society, Indianapolis, IN, April 23-27, 1989.

"Correlation between the activation enthalpy and the breadth of the electric modulus spectrum," Annual Meeting of the American Ceramic Society, Indianapolis, IN, April 23-27, 1989.

"ac/dc studies of non-exponential processes in superionic conductors: Correlation of conductivity & NMR studies," MRS Fall Meeting, Boston, MA, November 28 - December 2, 1988.

"Preparation and characterization of new high Tg 8-14 μm IR transparent chalcogenide glasses," Gordon Research Conference on Glass, Tilton School, Tilton, NH, August 1-5, 1988 (poster).

"Conductivity activation energy relations in high alkali borate glasses," Advanced Study Institute on Science and Technology of Fast Ion Conductors, Erice, Sicily, Italy, July 1-15, 1987.

"Na^{+}-ion conductivity in $xNa_2O + (1-x)NaPO_3$ glasses," Annual Meeting of the American Ceramic Society, Pittsburgh, PA, April 26-29, 1987.

"Activation energy relations in sodium aluminoborate glasses," Annual Meeting of the American Ceramic Society, Chicago, IL, April 27-May 1, 1986.

"Electrical relaxation in sodium aluminoborate glasses: Compositional variations," Annual Meeting of the American Ceramic Society, Chicago, IL, April 27-May 1, 1986.

"Enthalpy relaxation in the transition region of P_2O_5 and binary $Li_2O + P_2O_5$ glasses," Annual Meeting of the American Ceramic Society, Chicago, IL, April 27-May 1, 1986.

"Sequential dampings due to fast ion diffusion and structural relaxation in $(AgI)_x (AgPO_3)_{1-x}$ ionic liquids," 5th International Conference on Solid State Ionics, Lake Tahoe, NV, August 18-24, 1985.

"Transport and thermodynamic properties of AgI - Ag Oxysalt(s) glasses," 5th International Conference on Solid State Ionics, Lake Tahoe, NV, August 18-24, 1985.

"On the relationships between the glass transition and the ionic conductivity in glass," 5th International Conference on Solid State Ionics, Lake Tahoe, NV, August 18-24, 1985.

"Relationships between conductivity and apparent glass basicity. Conductivity maximum in glass," 5th International Conference on Solid State Ionics, Lake Tahoe, NV, August 18-24, 1985.

"Phosphate glasses: Unusual properties, intriguing chemistry," Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 29-May 2, 1985.

"Conductivity maximum in sodium aluminoborate glass," NATO Advanced Study Institute - Current Topics in Glass, Tenerife, Spain, April 2-13, 1984.

Invited Papers or Seminars:

251. "Beyond Lithium and Towards Sodium: Thin-Film Glassy Solid Electrolytes as a New Functionality for Glass Enabling High Energy Density All Solid-State Na Batteries," Beyond Lithium -14, Knoxville, TN, July 23, 2024.

250. "Recent Progress on New Mixed-Glass-Former Mixed-Oxy-Sulfide Glassy Solid Electrolytes – New NaPSiSO GSEs," Annual Meeting of the Glass and Optical Division of the American Ceramic Society, Las Vega, NV, May 23, 2024.

249. "Recent Progress Towards Electrochemically Stable, Thin Film, and High Conductivity NaPSON and NaPSiSO Glassy Solid Electrolytes," Annual Meeting of the Materials Research Society, Seattle, WA, April 24, 2024.

248. "Recent Progress Towards Electrochemically Stable, Thin Film, and High Conductivity NaPSiSO Glassy Solid Electrolytes," Spring Annual Meeting of American Chemical Society, April 19, 2024.

247. "A Brief Review of Glassy Solid Electrolytes," University of Muenster, Muenster, Germany, April 15, 2024.

246. "NaPSON Glasses: The role of Nitrogen Doping on the Structure and Properties of a New Class of Glassy Solid Electrolytes," University of Muenster, Muenster, Germany, April 16, 2024.

245. "Recent Progress Towards Electrochemically Stable, Thin Film, and High Conductivity NaPSON and NaPSiSO Glassy Solid Electrolytes," University of Marburg, Marburg, Germany, April 18, 2024.

244. "Recent Progress Towards Electrochemically Stable, Thin Film, and High Conductivity NaPSON and NaPSiSO Glassy Solid Electrolytes," Materials Research Society Spring Meeting, Seattle, WA, April 24, 2024.

243. "Recent Progress on New Mixed-Glass-Former Mixed-Oxy-Sulfide Glassy Solid Electrolytes – New NaPSiSO GSEs," The American Ceramics Society Glass and Optical Materials Spring 2024 Meeting, May 23, 2024.

242. "Loose Ions on a Disordered Landscape….An Enabling Paradigm for All Solid State Lithium Batteries", Iowa Engineers, Des Moines, IA, October 19, 2023

241. "Loose Ions on a Disordered Landscape: An Enabling Paradigm for New All Solid State Batteries," Materials Science and Technology 2023, Columbus, OH, October 9, 2023

240. "Loose Ions on a Disordered Landscape: An Enabling Paradigm for New All Solid State Batteries," University of Rennes, Rennes, France, September 11, 2023

239. "Loose Ions on a Disordered Landscape: An Enabling Paradigm for New All Solid State Batteries," Annual Meeting of the Society of Glass Technology, Cambridge, England, September 14, 2023.

238. "Loose Ions on a Disordered Landscape: An Enabling Paradigm for New All Solid State Batteries," Corning Glass Summit, Corning, NY, May 24, 2023

237. "Loose Ions on a Disordered Landscape: Towards a More Complete Understanding of Conduction Energetics," University of Muenster, Muenster Electrochemical Energy and Technology Center, Muenster, Germany, September 29, 2022

236. "Loose Ions on a Disordered Landscape: Towards a More Complete Understanding of Conduction Energetics," 2nd Energy Landscapes and Structures in Ion Conductors Workshop and Bunsen-Kolloquium, Göttingen, Germany, September 26-28, 2022

235. "New Glassy Solid Electrolytes: Towards High Energy Density Safe All Solid-State Batteries," University of Texas: Dallas LEAP Manufacturing Next-Gen Battery Workshop, Virtual Meeting, September 2022.

234. "Loose Ions on a Disordered Landscape: An Enabling Paradigm for New All Solid State Batteries," Department of Physics, Iowa State University, September 2022.

233. "New Thin Film Glassy Solid Electrolytes for New All Solid-State Batteries," American Chemical Society Fall 2022 Annual Meeting, Division of Energy and Fuels, Session: Sulfide-Based Solid-State Electrolytes & Batteries, August 2022.

232"Energy Storage Research at Iowa State University," Johnson Energy Storage, LLC, Atlanta, GA, July 2022.

"New Thin Film Glassy Solid Electrolytes for New All Solid-State Batteries," Department of Materials Science, University of California at Davis, May 2022

"Thin Film Glassy Solid Electrolytes for New All Solid-State Batteries," Material – AZ, Joint Seminar Program between University of Arizona and Arizona State University, October 2021.

"Solid State Battery Brainstorming Workshop," Virtual Meeting, Oak Ridge National Laboratory, July 2020.

"Characterization of Lithium Thiosilicophosphate Glasses Made by High Energy Planetary Ball Milling," Virtual Glass and Optical Materials Division Annual Meeting, August 2020.

"New Glassy Solid Electrolytes Lead to Break Through in Battery Safety and Performance," NASA Jet Propulsion Laboratory, November 2019.

"Thin-Film Glassy Solid Electrolytes: a New Functionality for Glass Enabling High Energy Density Li and Na Batteries," Electrochemical Society Annual Meeting, Atlanta, October 2019.

"Thin-Film Glassy Solid Electrolytes: a New Functionality for Glass Enabling High Energy Density Li and Na Batteries," Glass and Optical Materials Division, Alfred R. Cooper Session, Materials Science & Technology Annual Meeting, Portland, OR, October 2019.

"Loose Ions on a Disordered Landscape: An Enabling Paradigm for All Solid State Lithium and Sodium Batteries," Department of Physics, Coe College, Cedar Rapids, IA, July 2019.

"Loose Ions on a Disordered Landscape: An Enabling Paradigm for Strong Glasses and Fast Ions," Joint 25th International Congress on Glass and Glass and Optical Materials Division of the American Ceramic Society Meeting, Boston, MA, June 2019.

"Loose Ions on a Disordered Landscape: An Enabling Paradigm for All Solid State Sodium Batteries," Department of Chemistry, Florida State University, February 2019.

"Loose Ions on a Disordered Landscape: An Enabling Paradigm for All Solid State Sodium Batteries," Glasses and Polymers: The Science of Disorder, Messina Italy, November 2018

"New Solid State Na+ Ion Conducting Glassy Solid Electrolytes: Density and Tg Relationships to Structure in the Na Si P S MGF System," Materials Science & Technology 2018, Columbus, OH, October 2018.

"New developments in fast in conducting glasses: Towards enabling a new paradigm of high energy density and battery safety," 21st University Conference on Glass, Pennsylvania State University, August 2018

"New Solid State Na+ Ion Conducting Glassy Solid Electrolytes and Their Use in New All Solid State Sodium Batteries," 15th International Conference on the Physics of Non-Crystalline Solids and the 14th European Society of Glass Conference, Str. Malo, France, July 2018.

"New Solid State Na+ Ion Conducting Glassy Solid Electrolytes and Their Use in New All Solid State Sodium Batteries," 21st International Symposium on Non-Oxide Glasses, Quebec City, Quebec, Canada, June 2018.

"Building Big Research – From Concept to Capital Next Generation Batteries for Mission Enabling Energy Storage Systems," NIH, NIGMS Seventh Biennial National IDeA Symposium of BioMedical Research Excellence," Washington, D, June 2018.

"Towards New All Solid State Li and Na Batteries: Glass the Enabling Material," Annual Meeting of the Glass and Optical Materials Division of the American Ceramic Society, San Antonio, TX, May 2018.

"Towards New All Solid State Li and Na Batteries: Glass the Enabling Material," 2018 Conference on Electronic and Advanced Materials, Orlando, FL, January 2018.

"Extreme Entropy Mixed Glass Former Glasses," Materials Science & Technology, Technical Meeting and Exhibition, Pittsburgh, PA, October 2017.

"The Structure of and Li+- ion Conduction in New Solid Electrolyte Glasses: Towards Safer, Cheaper, and More Powerful Batteries," Department of Chemical and Materials Engineering, University of Rochester, Rochester, NY, September 2017.

"On the Competitive Roles of B and P in the Structures of Mixed Glass Former Glasses," Borate & Phosphate 2017, Oxford, England, July 2017.

"On the Competitive Roles of B and P in the Structures of Mixed Glass Former Glasses," XI BrazGlass, Curitiba, Brazil, July 2017.

"Structure and Dynamics of Fast Ion Conducting Chalcogenide Glasses: A 30 Year Quest for Faster and Better," PACRim 2017, Waikoloa, HI, May 2017.

"On the Role of Boron on the Structure and Properties of Mixed Glass Former Na^+ Ion Conducting Glassy Solid Electrolytes," LeTourneau University, Longview, TX, November 2016.

"On the Negative Mixed Glass Former Effect in Sodium Thio-Germanophosphate Solid Electrolyte Glasses," Department of Chemical and Materials Science & Engineering, Univesity of Kentucky, Lexington, KY, October 2016.

"On the Negative Mixed Glass Former Effect in Sodium Thio-Germanophosphate Solid Electrolyte Glasses," Materials Science and Technology Conference, Salt Lake City, UT, October 2016.

"Na^+ Ion Conduction In and Relation to the Structure of New Mixed Glass Former Solid Electrolytes," Department of Physical Chemistry, Muenster Electrochemical Energy and Technology Research Center, University of Muenster, Muenster, Germany, July 2016.

"Development and Characterization of Fast Ion Conducting Solid Electrolytes for All-Solid-State Sodium Batteries," Department of Physics, University of Dortmund, Dortmund, Germany, July 2016.

"Comparative Structures, Na^+ Ion Conductivities, and Glass Transition Studies of Melt Quenched and Mechanically Milled $Na_2S + P_2S_5$ Glassy Solid Electrolytes," 2016 Annual Meeting of the Glass and Optical Materials Division of the American Ceramic Society, Madison, WI, May 2016.

"On the Role of Boron on the Structure and Properties of Mixed Glass Former Na^+ Ion Conducting Glassy Solid Electrolytes," Department of Materials Science and Engineering, East China University of Technology, Shanghai, China, April 2016.

"Na^+ Ion Conduction In and Relation to the Structure of New Mixed Glass Former Solid Electrolytes," 24th International Congress on Glass, Shanghai, China, April 2016.

"Lessons Learned From 30 Years At the Front of the Classroom," 24th International Congress on Glass, Shanghai, China, April 2016.

"On the Role of Boron on the Structure and Properties of Mixed Glass Former Na^+ Ion Conducting $Na_2O + B_2O_3 + P_2O_5$ Glassy Solid Electrolytes," Department of Mechanical and Materials Engineering, Washington State University, Pullman, WA, February 2016.

"On the Negative Mixed Glass Former Effect in Sodium Thio-Germanophosphate Solid Electrolyte Glasses," NANOPIA 2015, Changwon, South Korea, November 2015.

"On the Negative Mixed Glass Former Effect in Sodium Thio-Germanophosphate Solid Electrolyte Glasses," University of Ulsan, Department of Chemical Engineering, Ulsan, South Korea, November 2015.

"On the Negative Mixed Glass Former Effect in Sodium Thio-Germanophosphate Solid Electrolyte Glasses," Ulsan National Insitute of Science and Technology, Ulsan, South Korea, November 2015.

"On the Negative Mixed Glass Former Effect in Sodium Thio-Germanophosphate Solid Electrolyte Glasses," POSCO Research Instutee of Science and Technology, Global Research and Development, Incheon, South Korea, November 2015.

"Sodium Borosilicate Glasses: New Studies Yield Fresh Insights into Mechanisms of Ion Conduction in Mixed Glass Former Glasses," Materials Science and Technology 2015, Columbus, OH, October 2015.

"Towards the Search for New Low Temperature Low Cost Sodium Batteries for Grid Scale Energy Storage," TechConnect World Innovation Conference and Exposition, Washington, DC, June 2015.

"On the Role of Boron on the Structure and Properties of Mixed Glass Former Na^+ Ion Conducting Glassy Solid Electrolytes," Electronic Materials and Applications, EMA 2015, Orlando, FL, January 2015.

"On the Role of Boron on the Structure and Properties of Mixed Glass Former Na^+ Ion Conducting $Na_2O + B_2O_3 + P_2O_5$ Glassy Solid Electrolytes," Department of Mechanical Engineering, Tuskegee University, Tuskegee, AL, December 2014

"Structure, composition, and ionic conductivity of $nLi_2S + GeS_2$, n = 1, 2, 3, and 4, amorphous thin film electrolytes for solid state Li-ion batteries," Honda Research Institute, Columbus, OH, November 2014.

"On the Role of Boron on the Structure and Properties of Mixed Glass Former Na^+ Ion Conducting $Na_2O + B_2O_3 + P_2O_5$ Glassy Solid Electrolytes," Department of Mechanical Engineering, University of South Carolina, November 2014.

"Na^+ Ion Conduction in and the Structure and Properties of New Mixed Glass Former Solid Electrolytes for Low Temperature Sodium Batteries," NANOPIA 2014, Changwon, Republic of Korea, November 2014.

"Comparative Structures, Na^+ Ion Conductivities, and Glass Transition Studies of Melt Quenched and Mechanically Milled $Na_2S + P_2S_5$ Glassy Solid Electrolytes," Center for Research, Technology and Education in Vitreous Materials, Department of Materials Engineering, Federal University of São Carlos, Sao Carlos, Brazil, November 2014.

"Structure, Properties, and Na^+ Ion Conductivity in Mixed Glass Former Glasses, $0.33Na_2O + 0.67[xB_2O_3 + 2(1-x)SiO_2]$," X BraSGlass, Sao Carlos, Brazil, October 2014.

"On the Role of Boron on the Structure and Properties of Mixed Glass Former Na^+ Ion Conducting $Na_2O + B_2O_3 + P_2O_5$ Glassy Solid Electrolytes," Department of Chemistry, Capital University, Bexley, OH, October 2014.

"On the Structure and Properties of New Mixed Glass Former Solid Electrolytes for All Solid State Sodium Batteries," International Conference on Material Science and Technology 2014, Pittsburgh, PA, October 2014.

"On the Structure and Properties of New Mixed Glass Former $Na_2S + GeS_2 + PS_{5/2}$ Glassy Solid Electrolytes for Low Temperature All Solid State Sodium Batteries," Muenster Electrochemical Energy and Technology Research Center, Muenster, Germany, August 2014.

"Na^+ Ion Conduction and Diffusion in and Relation to the Structure and Properties of New Mixed Glass Former Solid Electrolytes for Low Temperature Sodium Batteries," Diffusion in Materials – 2014, University of Muenster, Muenster, Germany, August 2014

"On the Role of Boron on the Structure and Properties of Mixed Glass Former Na^+ Ion Conducting $Na_2O + B_2O_3 + P_2O_5$ Glassy Solid Electrolytes," The 8th International Meeting on Borate Glasses, Melts, and Crystals & The International Conference on Phosphate Glasses," Pardubice, Czech Republic, July 2014.

"On the Role of Unequal Sharing of Alkali Ions in the Mixed Glass Former Effect in $Na_2S + PS_{5/2} + GeS_2$ Glasses," Schott AG, Central Research and Development Center, Mainz, Germany, June 2014.

"On the Role of Unequal Sharing of Alkali Ions in the Mixed Glass Former Effect in $Na_2S + PS_{5/2} + GeS_2$ Glasses," Department of Physics, University of Darmstadt, Darmstadt, Germany, June 2014.

"On the Role of Unequal Sharing of Alkali Ions in the Mixed Glass Former Effect in $Na_2S + PS_{5/2} + GeS_2$ Glasses," Department of Physical Chemistry, University of Marburg, Marburg, Germany, June 2014.

"On the Role of Unequal Sharing of Alkali Ions in the Mixed Glass Former Effect in $Na_2S + PS_{5/2} + GeS_2$ Glasses," Department of Physics, University of Osnabrück, Osnabrück, Germany, June 2014.

"On the Role of Boron on the Structure and Properties of Mixed Glass Former Na^+ Ion Conducting $Na_2O + B_2O_3 + P_2O_5$ Glassy Solid Electrolytes," Prairie View A&M University, Prairie View, TX, March 2014.

"On the Negative Mixed Glass Former Effect in Sodium Thio-Germanophosphate Solid Electrolyte Glasses," Department of Materials Science & Engineering, University of Arizona, Tucson, AZ, March 10, 2014.

"On the Role of Boron on the Structure and Properties of Mixed Glass Former Na^+ Ion Conducting $Na_2O + B_2O_3 + P_2O_5$ Glassy Solid Electrolytes," Department of Chemistry, Division of Physical Chemistry, Iowa State University, February 14, 2014.

"On the Negative Mixed Glass Former Effect in Sodium Thio-Germanophosphate Solid Electrolyte Glasses," Department of Mechanical Engineering, University of Colorado, Boulder, Co, October 2013.

"Comparative Structures, Na^+ Ion Conductivities, and Glass Transition Studies of Melt Quenched and Mechanically Milled $Na_2S + P_2S_5$ Glasses," Department of Applied Chemistry, Osaka Prefecture University, Osak, Japan, August 2013.

"On the Role of Boron in $Na_2O + B_2O_3 + P_2O_5$ Solid Electrolyte Glasses – Correlations to the Atomic Level Structures and Na^+ Ionic Conductivity of Glass," Department of Materials Science & Engineering, Gyeongsang National University, Jinju, Korea, August 2013.

"The Structure of and Li^+ ion Conduction in Lithium Germanium Oxy-Sulfide Glasses," Research Institute of Interdisciplinary Science and Technology, RIST, Pohang, Korea, August 2013

"Structure, composition, and ionic conductivity of $nLi_2S + GeS_2$ (n=1, 2, and 3) amorphous thin film electrolytes for solid state Li-ion batteries," Research Institute of Interdisciplinary Science and Technology, RIST, Pohang, Korea, August 2013.

"On the Role of Boron in $Na_2O + B_2O_3 + P_2O_5$ Solid Electrolyte Glasses – Correlations to the Atomic Level Structures and Na^+ Ionic Conductivity of Glass," POSTECH - Pohang University of Science and Technology, Pohang, Korea, August 2013.

"Fostering Successful International Student Research," National Science Foundation, Division of Materials Research, Ceramics Program Principal Investigators Meeting, Washington, D.C., June 2013.

"Structure, composition, and ionic conductivity of $nLi_2S + GeS_2$, n = 1, 2, 3, and 4, amorphous thin film electrolytes for solid state Li-ion batteries," Department of Chemistry, Arizona State University, Tiempe, AZ, June 2013.

"On the Role of Boron in $Na_2O + B_2O_3 + P_2O_5$ Solid Electrolyte Glasses – Correlations to the Atomic Level Structures and Na^+ Ionic Conductivity of Glass," Central Research and Development Center, 3M, St. Paul, MN, April 2013.

"On the Role of Boron in $Na_2O + B_2O_3 + P_2O_5$ Solid Electrolyte Glasses – Correlations to the Atomic Level Structures and Na^+ Ionic Conductivity of Glass," Department of Materials Science & Engineering, Univesity of North Texas, Denton, TX, April 2013.

"On the Role of Boron in $Na_2O + B_2O_3 + P_2O_5$ Solid Electrolyte Glasses – Correlations to the Atomic Level Structures and Na^+ Ionic Conductivity of Glass," Department of Chemistry, University of Rome – La Sapiensa, Rome, Italy, March 2013.

"Glasses for Energy Storage: Advancing the Energy Density and Safety of Lithium Batteries," Department of Materials Science & Engineering, Missouri University of Science & Technology, Rolla, MO, February , 2013.

"Structure, composition, and ionic conductivity of $nLi_2S + GeS_2$, n = 1, 2, 3, and 4, amorphous thin film electrolytes for solid state Li-ion batteries," Department of Physics, University of Messina, Messina, Sicily, Italy, January 2013.

"On the Role of Boron in $Na_2O + B_2O_3 + P_2O_5$ Solid Electrolyte Glasses – Correlations to the Atomic Level Structures and Na^+ Ionic Conductivity of Glass," Department of Physics, University of Messina, Messina, Sicily, Italy, January 2013.

"Fundamentals of the Glassy State – The Glass Transition is a Kinetic Transition with Thermodynamic Connections," Department of Physics, University of Messina, Messina, Sicily, Italy, January 2013.

"Glasses for Energy Storage: Advancing the Energy Density and Safety of Batteries," International Conference on Functional Glasses: Properties and Applications for Energy and Information," Siracusa, Sicily, Italy, January 2013.

"Mixed Glass Former Effects on the Properties and Structures of Glass," 6^{th} Symposium on Functional Glasses and International Forum on New Photoelectric Materials, South China University of Technology, Guangzhou, China, November 2012.

"Structure, Composition, and Ionic Conductivity of $nLi_2S + GeS_2$ (n=1, 2, 3, and 4) Amorphous Thin Films Electrolytes for Solid State Li-Ion Batteries," School of Materials Science & Engineering, South China University of Technology, Guangzhou, China, November 2012.

"Mixed Glass-Former Effects on the Properties and Structures of Glass," Materials Science & Technology 2012 Conference & Exhibition, Pittsburgh, PA, October 2012.

"IMI-NFG's Innovations in Advanced Glass Education and its Global Impact," Lehigh University, Department of Materials Science and Engineering, Bethlehem, PA, September 2012.

"Comparative Structures, Na^+ Ion Conductivities, and Glass Transition Studies of Melt Quenched and Mechanically Milled $Na_2S + P_2S_5$ Glasses," 18^{th} International Symposium on Non-Oxide Glasses," St. Malo, France, July 2012.

"New Studies of Ion Conduction in Phosphate-Based Mixed Glass Former Glasses," American Ceramic Society, Glass and Optical Materials Division Annual Meeting, St. Louis, MO, May 2012

"Glass Transition Studies of Mechanically Milled $Na_2S + P_2S_5$ Glasses," American Ceramic Society, Glass and Optical Materials Division Annual Meeting, St. Louis, MO, May 2012

"Structure, composition, and ionic conductivity of $nLi_2S + GeS_2$ (n=1, 2, and 3) amorphous thin film electrolytes for solid state Li-ion batteries," Department of Electrical and Computer Engineering, University of Oklahoma, Norman, OK, April 2012

"On the Role of Boron in $Na_2O + B_2O_3 + P_2O_5$ Solid Electrolyte Glasses – Correlations to the Atomic Level Structures and Na^+ Ionic Conductivity of Glass," Chemical Engineering Division, Argonne National Laboratory, Argonne, IL, April 2012

"On the Role of Boron in $Na_2O + B_2O_3 + P_2O_5$ Solid Electrolyte Glasses – Correlations to the Atomic Level Structures and Na^+ Ionic Conductivity of Glass," Schott AG, Central Research and Development, Mainz, Germany, March 2012.

"Structure, composition, and ionic conductivity of $nLi_2S + GeS_2$, n=1, 2, 3, and 4, amorphous thin film electrolytes for solid state Li-ion batteries," University of Dortmund, Department of Physics, Dortmund, Germany, March 2012.

"On the Role of Boron in $Na_2O + P_2O_5 + B_2O_3$ Solid Electrolyte Glasses – Correlations to Atomic Level Structure of Glass," Univesity of Madrid Autonoma, Consejo Superior de Investigaciones Cientificas, Instituto de Ceramica y Vidrio, Madrid, Spain, March 2012.

"On the Role of Boron in $Na_2O + P_2O_5 + B_2O_3$ Solid Electrolyte Glasses – Correlations to Atomic Level Structure," School of Materials Science and Engineering, Clemson University, March 2012.

"Mixed Glass Former Phenomena in $Na_2O + P_2O_5 + B_2O_3$ Glasses – Correlations to Atomic Level Structure of Glass," Korean Institute of Energy Research, Daejon, Korea, February 2012.

"Mixed Glass Former Phenomena in $Na_2O + P_2O_5 + B_2O_3$ Glasses – Correlations to Atomic Level Structure of Glass," Graduate School of Green Technology, Chungnam National University, Daejon, Korea, February 2012.

"Ionic Conduction in Trivalent Doped Tetrahedral Networks: $MI+M_2S+[0.1Ga_2S_3+0.9GeS_2]$, M = Li, Na, K and Cs Glasses," Department of Materials Science and Engineering, Gyeongsang National University, Jinju, Korea, February 2012.

"Mixed Glass Former Phenomena in $Na_2O + P_2O_5 + B_2O_3$ Glasses – Correlations to Atomic Level Structure of Glass," Department of Materials Science and Engineering, Gyeongsang National University, Jinju, Korea, February 2012.

"Mixed Glass Former Phenomena in $Na_2O + P_2O_5 + B_2O_3$ Glasses – Correlations to Atomic Level Structure of Glass," Korean Institute of Materials Science, Changwon, Korea, January 2012.

"Review of Fast Ionic Conducting Glasses," Korean Institute of Materials Science, Changwon, Korea, January 2012.

"Ionic Conduction in Trivalent Doped Tetrahedral Networks: $MI+M_2S+[0.1Ga_2S_3+0.9GeS_2]$, M = Li, Na, K and Cs Glasses," Department of Materials Science and Engineering, Changwon National University, Changwon, Korea, January 2012.

"Mixed Glass Former Phenomena in $Na_2O + P_2O_5 + B_2O_3$ Glasses – Correlations to Atomic Level Structure of Glass," Department of Materials Science and Engineering, Changwon National University, Changwon, Korea, January 2012.

"Mixed Glass Former Phenomena in $Na_2O + P_2O_5 + B_2O_3$ Glasses – Correlations to Atomic Level Structure of Glass," Owens-Corning Science & Technology Center, Granville, OH, October 2011.

"Mixed Glass Former Effects in $Na_2O + P_2O_5 + B_2O_3$ Glasses," Materials Science & Technology 2011 Conference and Exhibition, Columbus, Ohio, October 2011.

"Mixed Glass Former Phenomena in $Na_2O + P_2O_5 + B_2O_3$ Glasses," Department of Physics, University of Dortmund, Dortmund, Germany, September, 2011

"The Structure of and Li^+ Ion Conduction in $Li_2S + GeS_2 + GeO_2$ Oxy-Sulfide Glasses," Schott Glass AG, Workshop on Melting Under Controlled Conditions, Mainz, Germany, September 2011.

"The Structure of and Li^+ Ion Conduction in $Li_2S + GeS_2 + GeO_2$ Oxy-Sulfide Glasses," Department of Physics, University of Darmstadt, Darmstadt, Germany, September 2011.

"New Solid Electrolytes for New Batteries," 2011 National Alliance for Advanced Technology Batteries Annual Meeting and Conference, Louisville, KY, September 2011.

"Structure and Dynamics of Fast Ion Motions in Glass: New Solid Electrolytes for High Energy Density Batteries," 19th University Conference on Glass, Rensselaer Polytechnic Institute, Troy, NY, August 2011.

"Glass Transition Temperatures in Mixed Glass Former Glasses," 30th Annual Meeting of the North American Thermal Analysis Society, Des Moines, IA, August 2011.

"New Chemistries for New Lithium Batteries for a Green Future: Why the Chevy Volt only goes 40 miles on a Charge," Iowa State University Chapter of Sigma XI , President's Lecture on the Occasion of the 90th Anniversary of the ISU Sigma XI Chapter, Ames, IA, April 2011.

"Fast Ion Conducting Glasses in the Light of the Lithium Battery Problem," Department of Electrical and Computer Engineering, Texas A & M University, College Station, TX, April 2011

"Li^+ ion conducting glasses: New materials for next generation Lithium batteries that are safer and more energy dense," NASA Glenn Research Center, Cleveland, OH, April 2011.

"Preparation and Characterization of New n = 2 IR Transparent Glasses," Pacific Northwest National Laboratory, Applied Physics and Sensing Program, Richland, WA, December 2010.

"The Structure of and Li^+ ion Conduction in Germanium Oxy-Sulfide Glasses," Department of Materials Science & Engineering, Cornell University, Ithaca, NY, September 2010.

"New Studies of Ionic Conduction in Glass: Effects of Mixed Glass Forming Anions and Cations on the Ionic Conductivity," School of Engineering, Alfred University, September 2010

"Structure, Composition, and Ionic Conductivities of $nLi_2S + GeS_2$ (n=1, 2, 3) Amorphous Thin Films Electrolytes for Solid State Batteries," Department of Materials Science & Engineering, Rensselaer Polytechnic Institute, Troy, NY, September 2010

"Preparation and Characterization of As-Se Glass Materials for Application of Single Mode Fiber," Optical Materials and Device Branch, Naval Research Laboratory, Washington, DC, September 2010.

"Preparation and Characterization of Fast Ion Conducting Lithium Thio-Germanate Thin Films Grown by RF Magnetron Sputtering," Division of Materials Science & Engineering, Argonne National Laboratory, June 2010.

"New Studies of Ionic Conduction in Glass: Effects of Mixed Glass Forming Cations and Anions of the Ionic Conductivity," International Bunsen Discussion Meeting on Motions of Ions in Disordered Materials," Univesity of Muenster, Muenster, Germany, February 2010

"Structure, Composition, and Ionic Conductivities of $nLi_2S + GeS_2$ (n=1, 2, 3) Amorphous Thin Films Electrolytes for Solid State Batteries," Central Research and Development Center, Schott AG, Mainz, Germany, February, 2010.

"Structure, Composition, and Ionic Conductivities of $nLi_2S + GeS_2$ (n=1, 2, 3) Amorphous Thin Films Electrolytes for Solid State Batteries," Advanced Institute of Science and Technology, Energy and Materials Research Park, Samsung, Inc., Seoul, South Korea, January 2010.

"Structure, Composition, and Ionic Conductivities of $nLi_2S + GeS_2$ (n=1, 2, 3) Amorphous Thin Films Electrolytes for Solid State Batteries," Korean Institute of Materials Science, Changwon, South Korea, January 2010

"Electrochemical Applications of Glass: New Functionalities for a Greener Future," Lehigh University-Pennsylvania State University-Zhejian National University, "Winter School on New Functionalities of Glass," Hangzhou, China, January 2010.

"Fundamentals of Glass: Applications Towards a Greener Future," A series of eight lectures on the Electrochemical Applications of Glasses in Energy Storage Systems, Gyeongsang National University, Junju, South Korea, January 2010.

"Fundamentals of Glass: Applications Towards a Greener Future," A series of eight lectures on the Electrochemical Applications of Glasses in Energy Storage Systems, Changwon National University, Changwon, South Korea, January 2010

"Lithium Batteries: Old Problems and New Opportunities for a Greener Future," Department of Physics, Marietta College, Marietta, OH, October 2009.

"Structure, Composition, and Ionic Conductivities of $nLi_2S + GeS_2$ (n=1, 2, 3) Amorphous Thin Films Electrolytes for Solid State Batteries," Department of Physics, Ohio University, Athens, OH, October 2009.

"Mixed Glass Former Effects in Alkali Oxy- and Thio-Borate Glasses," Alfred R. Cooper Honorary Session, Materials Science and Technology Meeting, Pittsburgh, PA, October 2009.

"Mixed Glass Former Effects in Alkali Oxy- and Thio-Borate Glasses," 6th International Discussion Meeting on Relaxation in Complex Systems, Rome, Italy, August 2009.

"Structure, Composition, and Ionic Conductivities of $nLi_2S + GeS_2$ (n=1, 2, 3) Amorphous Thin Films Electrolytes for Solid State Batteries," Oak Ridge National Laboratory, Division of Materials Science and Technology, Oak Ridge, TN, September 2009.

"Li^+ ion Conducting Glasses: New Materials for Next Generation Lithium Batteries That are Safer and More Energy Dense," LYNNTECH, Inc, Austin, TX, July 2009.

"Mixed Glass-Former Effects in Alkali Oxy- and Thio-Borosilicate and Borophosphate Glasses," 17th International Meeting on Solid State Ionics, Toronto, Canada, June 2009.

"Ionic Conduction in Glass: A Review in Light of the Lithium Battery Problem," 8th Pacific Rim Conference on Ceramic and Glass Technology, Vancouver, BC, Canada, June 2009

"Fast Ion Conduction in Glass: Mixed Glass Former and Mixed Anion Effects," 8th Pacific Rim Conference on Ceramic and Glass Technology, Vancouver, BC, Canada, June 2009

"Fast Ion Conduction in Glass: Towards New Solid Electrolytes for High Performance Lithium Batteries," SCHOTT AG, Research and Technology Development Center, Mainz, Germany, February 2009

"Structure and Dynamics of Fast Ion Motions in Glass - New Insights Gained from NMR and Conductivity Studies of Ion Diffusion," Department of Materials Science & Engineering, Changwon National University, Changwon, South Korea, January 2009

"Alkali Thio-Hydroxometallates: A New Class of Intermediate Temperature Proton Conducting Ceramic Membranes," Department of Materials Science & Engineering, Changwon National University, Changwon, South Korea, January 2009

"Structure and Conductivity in Li-Ga-Ge Sulfide Glasses: Towards Breaking the Low Tg, but High Conductivity Paradigm in Glass," Department of Materials Science & Engineering, Changwon National University, Changwon, South Korea, January 2009

"Structure and Dynamics of Fast Ion Motions in Glass - New Insights Gained from NMR and Conductivity Studies of Ion Diffusion," Department of Materials Science & Engineering, Gyeongsang National University, Gyeongsang, South Korea, January 2009

"Structure and Dynamics of Fast Ion Motions in Glass - New Insights Gained from NMR and "Conductivity Studies of Ion Diffusion," Korea Institute of Energy Research, Daejun, South Korea, January 2009

"Structure and Dynamics of Fast Ion Motions in Glass - New Insights Gained from NMR and Conductivity Studies of Ion Diffusion," Department of Materials Science & Engineering, Hangyang University, Seoul, South Korea, January 2009

"Structure and Properties of Fast Ion Conducting Glasses," Department of Materials Science and Engineering, University of Hyogo, Himeji, Japan, August 2008.

"Anomalous Enhancement in the Ionic Conductivity of $Li_2S + GeS_2 + GeO_2$ Glasses," Osaka Municipal Technical Research Institute, Osaka, Japan, August 2008.

"Activation Energy Description of Ion Dynamics in Fast Ion Conducting Glasses," Department of Applied Chemistry, Osaka Prefecture University, Osaka, Japan, August 2008

"George W. Morey Award Lecture –Structure and Dynamics of Fast Ion Motions in Glass," Glass and Optical Materials Division Meeting of the American Ceramic Society, Tucson, AZ, May 2008

"The Structure of and Li^+- ion Conduction in Germanium Oxy-Sulfide Glasses," Department of Physics, Coe College, Cedar Rapids, IA, February 2008.

"Alkali Thio-Hydroxometallates: A New Class of Intermediate Temperature Proton Conducting Ceramic Membranes," Department of Materials Science and Engineering, Ohio State University, Columbus, OH, November 2007

"A new functionality of glass: Chalcogenide Glass Anodes for High Energy Density Lithium Batteries," Lehigh Univerity, NSF International Materials Institute Program Review Meeting, October 16, 2007.

"Anomalous ionic Conductivity increase in $Li_2S + GeS_2 + GeO_2$ Oxy-sulfide Gasses," Department of Applied Chemistry, Osaka Prefecture University, Osaka, Japan, July 2007.

"Distribution of Activation Energies Models of Ion Dynamics as Measured by Combined NMR and Ionic Conductivity Measurements: Towards a Unified Description of Ion Dynamics in Glasses," National Institute of Advanced Industrial Science and Technology, Osaka, Japan, July 2007.

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Kyoto Institute of Technology, Department of Chemistry and Materials Technology, Kyoto, Japan, July 2007.

"Anomalous ionic Conductivity increase in $Li_2S + GeS_2 + GeO_2$ Oxy-sulfide Gasses," Konan University, Department of Chemistry, Kobe, Japan, University, July 2007.

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Changwon National University, School of Nano & Advanced Materials Engineering, Changwon, Korea, July 2007.

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Kumoh National Insttute of Chemistry, Department of Applied Chemistry, Kumoh, Korea, July 2007.

"Anomalous ionic Conductivity increase in $Li_2S + GeS_2 + GeO_2$ Oxy-sulfide Gasses," Korean Institute of Materials Science, Department of Future Technology, Changwon, Korea, July 2007.

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Korean Electrotechnology Research Institute, Advanced Materials and Application Research Laboratory, Changwon, Korea, July 2007.

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Gyeongsang National University, School of Nano & Advanced Materials Engineering, Gyeongsang, Korea, July 2007

"Space Charge Polarization in Ion Conducting Materials: A New Method to Determine the Number of Mobile Charges in FIC Electrolytes," Department of Science, Systems, and Models, Roskilde University, Roskilde, Denmark, March 15, 2007.

"Space Charge Polarization in Ion Conducting Materials: A New Method to Determine the Number of Mobile Charges in FIC Electrolytes," Department of Chemistry, Aalborg University, Aalborg, Denmark, March 14, 2007.

"Alkali Thio-Hydroxometallates: A New Class of Intermediate Temperature Proton Conducting Ceramic Membranes," Carleton Life Support Systems, March 2, 2007

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Division of Science, Upper Iowa University, Fayette, IA, February 2007.

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Department of Materials Science and Engineering, University of Missouri-Rolla, Rolla, MO, February 2007.

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Department of Physics, Coe College, Cedar Rapids, IA, February 2007.

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Materials Research and Technology Development, Central Research and Development Center, Schott Glass, Mainz, Germany, February, 2007.

"Combined NMR and Ionic Conductivity Measurements of Fast Ion Conducting Thiogermanate and Thioborate Glasses," Department of Physics, Technical University of Darmstadt, Darmstadt, Germany, Janaury 2007.

"Distribution of Activation Energies Models of Ion Dynamics as Measured by Combined NMR and Ionic Conductivity Measurements: Towards a Unified Description of Ion Dynamics in Glasses," Department of Physics, University of North Carolina-Chapel Hill, Chapel Hill, NC, October 2006.

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Department of Physics, Ilmenau University, Ilmenau, Germany, July 2006.

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Department of Physics, University of Dortmund, Dortmund, Germany, July 2006.

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Department of Physical Chemistry, University of Muenster, Muenster, Germany, July 2006.

"The Structure of and Li+- ion Conduction in Germanium Oxy-Sulfide Glasses," Institut de Chimie de la Matière Condensée de Bordeaux, Universite Bordeuax 1, July 2006.

"Space Charge Polarization in Ion Conducting Materials: A New Method to Determine the Number of Mobile Charges in FIC Electrolytes," Glass and Optical Materials Division Spring Meeting of the American Ceramic Society, Greenville, SC, May 17-19, 2006

"Towards Higher Energy Density Li+ Ion Batteries, The Structure of and Li-ion conduction in Oxy-Sulfide Glasses," Department of Materials Science and Engineering, April 2006.

"Alkali Thio-Hydroxometallates: A New Class of Intermediate Temperature Proton Conducting Ceramic Membranes," Honda Research Initiation Grant Program, Chicago, IL, November 2005.

"Structure and Dynamics of the Glassy State: 1. Review of the Short Range Structure in Oxide and Sulfide Glasses," Visiting Professor, Department of Physics, University of Messina, Messina, Italy, October 2005

"Structure and Dynamics of the Glassy State: 2. Review of Fast Ion Dynamics in Glassy Solid Electrolytes," Visiting Professor, Department of Physics, University of Messina, Messina, Italy, October 2005

"Structure and Dynamics of the Glassy State: 3. Combined NMR and Ionic Conductivity Measurements of Fast Ion Conducting Thiogermanate and Thioborate Glasses," Visiting Professor, Department of Physics, University of Messina, Messina, Italy, October 2005

"Non-Arrhenius Fast Ion Conducting Glasses: Competition between Thermal Activation and Ion Trapping," 5th International Discussion Meeting on Relaxation in Complex Systems," Lille, France, July 7 – 12, 2005.

"Jubliee Professsorship Lecture: Study of the Proton Dynamics in a New Class of Oxy-Sulfide Proton Conducting Ceramics for Use in Intermediate Temperature H_2-O_2 Fuel Cells," Department of Applied Physics, Chalmers University of Technology, May 30, 2005.

"Synthesis and Characterization of a New Class of Ceramic Intermediate Temperature Proton Conducting Alkali Thiohydroxometallate Membranes for use in Proton Exchange Membrane Fuel Cells," NorFA Summer School on New Materials and Technologies for Low Temperature Fuel Cells, Smogen, Sweden, August 12-15, 2004

"Space Charge Polarization in Fast Ion Conducting Glasses: A Proposal to Determine the Number of Mobile Charges in FIC Electrolytes," 106th Annual Meeting of the American Ceramic Society, Indianapolis, IN, April 20, 2004.

"Space Charge Polarization in Fast Ion Conducting Glasses: A Method to Determine the Number Density of Mobile Charges in FIC Electrolytes," Department of Physics, Hunter College, NY, NY, May 3, 2004.

"Preparation and Characterization of New Proton Conducting Chalcogenide and Oxy-Chalcogenide Solid Electrolytes for PEM Fuel Cells," Chalmers University of Technology, Department of Applied Physics, January 30, 2004

"High Stability, High Conductivity Solid Electrolytes for Long Life and High Specific Energy Li-Ion Batteries," Jet Propulsion Laboratory, December 12, 2003

"Preparation and Characterization of New Proton Conducting Chalcogenide and Oxy-Chalcogenide Solid Electrolytes for PEM Fuel Cells," Department of Materials Science and Engineering, Global Fuel Cell Research Center, University of Connecticut, December 15, 2003

"Structure and Dyanmics in new Thioborate Glasses," Department of Chemistry, Drake University, November 7, 2003.

"Structure and Dynamics in new Thioborate Glasses," Fall Meeting of the Glass and Optical Materials Division of the American Ceramics Society, Corning, NY, October 12-15, 2003.

"Development of New Fast Proton Conducting Thioborate-Based Glasses for Use in Proton Exchange Membrane Fuel Cells," 16th University Conference on Glass, Rensselaer Polytechnic Institute, August 13-15, 2003.

"Structure and Dynamics of Fast Ion Conducting Thioborate-Based Glasses," 14th Inernational Conference on Solid State Ionics, Monterey, CA, June 23-27, 2003.

"Structure and Dynamics of Fast Ion Conducting Thioborate-Based Glasses," 105th Annual Meeting of the American Ceramic Society, Nashville, TN April 2003.

"Glass: What is it and Where did it come from?" Iowa State University, Brunnier Museum, April 13, 2003

"New Protonated Thioborate Glasses and Glass-Ceramic Materials," Coe College, Department of Physics, Cedar Rapids, IA, January 22, 2003,

"New Protonated Thioborate Glasses and Glass-Ceramic Materials and other Chalcogenide Materials Research at Iowa State University," NASA Langeley Research Center, Non-Destructive Evaluation Center, Hampton, VA December 9, 2002.

"Review of Polymeric Fast Ionic Electrolytes," Chalmers University of Science & Technology, Gothenburg, Sweden, December 6, 2002

"New Protonated Thioborate Glasses and Glass-Ceramic Materials," Clemson University, Department of Materials Science & Engineering, Clemson, SC, November 6, 2002

"Development of New Fast Proton Conducting Chalcogenide Membranes," University of Muenster, Department of Physical Chemistry, Muenster, Germany, June 19, 2002.
"Development of New Fast Proton Conducting Chalcogenide Membranes," University of Dortmund, Department of Physics, Dortmund, Germany, June 20, 2002.
"Development of New Fast Proton Conducting Chalcogenide Membranes," University of Montepellier II, Department of Chemistry, Montpellier, France, June 21, 2002
"Trapping Model of Non-Arrhenius Conductivity in FIC Glasses," European Centre for Atomic and Molecular Computations, CECAM Workshop on "Atomic Structure and Transport in Glassy Network," June 24-26, 2002, Lyon, France

"Non-Arrhenius Ionic Conductivity in FIC Chalcogenide Glasses," American Ceramic Society, 104th Annual Meeting, St. Louis, MO May 2002.

"Fast Ion Conducting Chalcogenide Glasses," Chemical Engineering Department, Iowa State University, October 2001.

"Fast Ion Diffusion in Optimized Glassy Electrolytes: Towards Higher Performance Batteries and Fuel Cells," Osborn Research Club, Iowa State University, October 2001.

"Nucleation and Growth in Inorganic Glass forming Liquids: A Brief Introduction," Department of Materials Science and Engineering, Iowa State University, September 2001.

"Non-Arrhenius Ionic Conductivity in FIC Glasses," 4th International Discussion Meeting on Relaxation in Complex Systems, Hersonnisos, Crete, Geece, June 2001

"Non-Arrhenius Ionic Conductivity in FIC Glasses," 103rd Annual Meeting of the American Ceramic Society, Indianapolis, IN, April 2001

"Conductivity and Nuclear Spin Relaxation Measurements of Fast Ion Conducting Chalcogenide Glasses," Univesity of Illinois, Department of Materials Science & Engineering, March, 2000

"Fast Ionic Conduction in Optimized Chalcogenide Glasses," Steve W. Martin, 198th Annual Meeting of the Electrochemical Society, Phoenix, AZ, October 2000.

"Distribution of Activation Energies Model of Ionic Conduction In Fast Ion Conducting Chalcogenide Glasses," Department of Chemistry, Arizona State University, October 2000.

"Distribution of Activation Energies Model of Ionic Conduction In Fast Ion Conducting Chalcogenide Glasses," Department of Chemistry, Iowa State University, October 2000.

"Distribution of Activation Energies Model of Ionic Conduction In Fast Ion Conducting Chalcogenide Glasses," Department of Materials Science and Engineering, Iowa State University, November, 2000.

"Distribution of Activation Energies Model of Ion Dynamics," Fall Meeting of the Glass and Optical Materials Division of the American Ceramic Society, Cleveland, Ohio, October 1999.

"Fast Ionic Conduction in Phosphate Glasses," 15th University Conference on Glass: Structure, Properties and Applications of Phosphate and Phosphate Containing Glasses," University of Missouri-Rolla, Rolla, Missouri, June 1999.

"Panel Session on Glasses, Molten Salts, Ionic Liquids, and Glasses", Panel Session Leader, International Symposium in the Honor of Professor C. Austen Angell, Pisa, Italy, September 26, 1998

"Ionic Conductivity in Optimized Chalcogenide FIC Glasses," XIth International Symposium on Non-Oxide and New Optical Glasses," Sheffield, England, September 6-10, 1998.

"Structure and Dynamics in New Fast Ion Conducting Chalcogenide Glasses," Physics of Glasses and Amorphous Materials, 4th International Summer School of the Universite' de Madrid Autonoma, Miraflores, Spain, September 14 - 18, 1997.

"Affect of Anion Substitution on the Structure and properties of Glass", 14th University Conference on Glass, Lehigh University, Bethlehem, PA, June 14, 1997

"Alkali Thioborate Glasses: Unique Structures and Unusual Properties", 2nd International Conference on Borate Glasses, in the Honor of Professor Philip J. Bray, Abingdon, England, United Kingdom, July 23, 1996

"Fast Ion Conducting Glasses: Structures, Properties, and Applications as Solid State Electrolytes", Moletech Corporation, Tucson, AR, December 18, 1995.

"On the Interaction of Silica-based Laser Optical Fibers with Tissue", Iowa State University Section of American Society for Non-Destructive Testing, November 2, 1995

"Fast Ion Conduction in New Chalcogenide Glasses", 97th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 1995

"Challenges and Opportunities in FIC Glasses", DOE Workshop on Diffusion and Relaxation in Amorphous Materials, Grandlebaken Resort, Lake Tahoe, NV, March 1995

"Fast ionic conduction in solids: old problems and new opportunities," Motorola Corporation, Northbrook, IL, November 22, 1994.

"Glass Transition Temperatures and heat capacities of alkali thioborate glasses", North American Thermal Analysis Society Spring Meeting, May 1994

"Dynamics and structure of new chalcogenide glasses," Purdue University, November 19, 1993.

"Dynamics and structure of new chalcogenide glasses," University of Illinois, November 18, 1993.

"Fast Ion Conducting Glasses: Structures, Properties, and Applications as Solid State Electrolytes," Exploratory Battery Division, Sandia National Laboratory, November 10, 1993.

"Dynamics and structure of new chalcogenide glasses," Coe College, September 1993.

"Ionic Conductivity Relaxations in Glass: Compositional Contributions and Non-Exponential Relaxations," Ceramic and Glass Division, Sandia National Laboratory, May 17, 1993.

"Dynamics and Structure of Fast Ion Conducting Glasses," Materials Science Division, Argonne National Laboratories, April 30, 1993.

"Dynamics and Structure of Fast Ion Conducting Inorganic Glasses," 95th Annual Meeting of the American Ceramic Society, Cincinnati, OH, April 19-22, 1993.

"Fast ion conduction in inorganic glasses," Motorola Corporation, Ft. Lauderdale, FL, August 20, 1992.

"Ion dynamics in glass," Fall Meeting of the Glass and Optical Materials Division of the American Ceramic Society, Evergreen Conference Center and Resort, Stone Mountain, GA, August 19, 1992.

"Fast ion conduction in glass: Familiar features and peculiar puzzlements," Gordon Conference on Solid State Ionics, Colby-Sawyer College, New London, NH, June 22-26, 1992.

"Relaxations in glass on the time scale of minutes to picoseconds," Department of Physics, Coe College, Cedar Rapids, IA, September 1986.

"Brillouin light scattering in superionic conducting liquids and glasses," Physik-Institut, Universitat Zurich, Zurich, Switzerland, December 1984.

"Fast ion conduction in glass. Composition/structure relationships," Department of Physics, Chalmers University of Technology, Gothenburg, Sweden, November 1984.

"Fast ionic conduction in alkali oxide glasses. Conductivity maximum in glass," Department of Physics and Chemical Physics, University of Di Pavia, Pavia, Italy, October 1983.

X. EXTENSION/OUTREACH/TECHNOLOGY TRANSFER ACTIVITIES

“Analysis and Characterization of Glass Fiber Mat Materials for use in lead Acid Batteries,” GNB Industrial Power, Lombard, IL, June 2001 – July 2001.

“Analysis and Characterization of the Catastrophic Fracture and Failure of Transmyocardial Revascularization Lenses,” Eclipse Surgical Technologies, May – June, 2000.

“Analysis of Surface Coating Materials for Float Glass,” project to analyze the composition and deposition technology for surface coatings for float glass, Guardian Industries, Inc., DeWitt, IA, July – December 1999.

“Development of High Thermal Expansion, High Hardness, Optical Glasses for Coupling Optical Fibers,” project to develop optically transparent glass with high thermal expansion coefficient and high hardness for use as a coupling glass in telecommunication optical fiber systems, E-TEK Dynamics, Inc., San Jose, CA, December 1998 – August 1999.

“Development of Inexpensive Transparent to Translucent Filter Assembly for Residential Windows Systems,” project to develop low cost controllable translucency system for residential window systems, Pella Windows, Inc., Pella, IA, January 1998 – May 1999.

"Analysis of the Optical Efficiency of Low Cost Plastic Optical Fiber-Based Large Panel Display Systems," project to analysis optical efficiency of plastic-fiber based display systems, FibreLite Incorporated, Des Moines, IA, November, 1998.

"Analysis of White Stone Defects in Guardian Float Glass," project to analyze white stone defects in float glass produced Guardian Industries, DeWitt, IA, May - June, 1997.

"Analysis of Clear Knot Defects in Guardian Float Glass", project to analyze clear knot defects and cords in float glass produced by Iowa float glass, Guardian Industries, located in DeWitt, IA, November - December, 1996.

"Preparation and Characterization of New Nanoscale Powders of Fast Ion Conducting Glasses", project to develop new fine particle sized powders of fast ion conducting glasses for use in new all-solid-state rechargeable lithium batteries, with Dr. Shyama Muhkerjee, Moltech Corporation, Tucson, AR, July, 1995 - December 1998.

"Development of New ULE Ultralow Expansion ULE Laser Optical Fiber for Laser Surgery", designed a new optical fiber specifically for laser surgery that remains stable in contact with tissue during laser surgery, with Dr. Gerald J. Shirk and Full Spectrum, Inc, a small Iowa based company. Technology transferred through signed license agreement with FSi, November 1994. Technology has patent pending, is FDA approved, is in use in surgery today and was winner of R&D 100 Award for 1995.

"Development of New Impedance Spectroscopy Software for Data Collection and Analysis", developed a new Windows compatible software for use with Impedance Spectroscopy data analysis, with Harry McMaken and HeartLand Software, Inc. Software transferred through signed license agreement with HeartLand, January 1994- December 1995.

XI. PATENTS

"Solid Electrolyte for Sodium Batteries," Yan Yao, Xiaowei Chi, Steven Kmiec, Steve W. Martin, Patent Application number 16/961,757, US Patent Publication number, US 2021/0066748 A1, Filed March 4, 2021 (Patent Pending)

"Method of Making High Purity Silicon Sulfide," Dmitriy Pavlovich Bayko, Steven Kmiec, Steve W. Martin, Publication Number US 2021/0292173 A, Filed December 1, 2020. (Patent Pending)

"Removal of Bubble from Molten Glass," Steve W. Martin, Ryan Gebhardt, Steven Kmiec, Jose Desouza, Seila Rojas, Attorney Socket Number 04802, Non-Provisional Patent Application Filed, March 15, 2019, Rejected February 16, 2023.

"Oxy-Thio-Nitride Mixed Network Former High Ion Conductivity Solid Electrolytes, Steve W. Martin, Attorney Socket Number 4451, Non-Provisional Patent Application Filed, U.S. Pat. Appl. Publ. (2018), US 20180069264 A1 20180308, September 7, 2017.

"Secondary Rechargeable Battery, Steve W. Martin, Attorney Socket Number 4436, Non-Provisional Patent Application Filed, U.S. Pat. Appl. Publ. (2018), US 20180083274 A1 20180322, March 22, 2018.

"Oxy-Thio-Nitride Mixed Network Former High Ion Conductivity Solid Electrolytes, Steve W. Martin, Attorney Socket Number 4451, Provisional Patent Application Filed, September 8, 2016.

"Secondary Rechargeable Battery, Steve W. Martin, Attorney Socket Number 4436, Provisional Patent Application Filed, September 16, 2016.

"Optically Transparent Glass Systems and Methods of Making Same," Steve W. Martin, Inseok Seo, and Emily Hammel, United States Patent Filed, Application Number 61512153, Filing Date, July 27, 2011, abandoned July 2012.

"Ionically Conducting Thin Films," Steve W. Martin, Bryce Campbell, Alan Constant, United States Patent Filed, December 14, 2007, Docket number, 900 237 US1, abandoned September 2009.

"Novel Copper Titanate Dielectrics and Methods for Making Same," David C. Cann, Eric A. Patterson, Steve W. Martin, Provisional Patent Application, United States Patent Office, ISURF Docket number 3297, Filed December 8, 2005, under Serial No. 60/748,542, abandoned November 29, 2006.

"Ion Conducting Materials," Steve W. Martin, Jason Saienga, ISURF docket number 03065, United States Patent Office, Provisional Filed October 7, 2003, Serial Number 60/509,210, Utility Regular Filed Octrober 7, 2004, Serial number 10/960,444.

"Mixed Anion Materials and Compounds for Novel Proton Conducting Membranes," Steve A. Poling, Carly R. Nelson, Steve W. Martin, ISURF docket number 03079, United States Patent Filed May 19, 2004, Serial Number 10/848,967, patent number 7,101527 issued September 5, 2006.

"Compounds for Novel Proton Conducting Membranes and Methods of Making Same," Steve A. Poling, Steve W. Martin, Jacob T. Sutherland, ISURF docket number 02894, United States Patent Filed July 25, 2003, Serial Number 10/627,584, patent number 7,018,604, issued March 26, 2006.

"Preparation of High Density Heavy Metal Flurode Glasses with Extended Ultraviolet and Infra Red Ranges, and Such High Density Heavy Metal Fluoride Glasses," Steve W. Martin, and Jesse Huebsch, United States Patent number 6,177,372, issued January 23, 2001.

"Methods for Laser Treatment of Tissue", Steve W. Martin, and Gerald J. Shirk, United States Patent, number 5,829,445, issued November 3, 1998.

"Method of Making a Surgical Laser Optical Fiber", Steve W. Martin and Gerald J. Shirk, United States Patent, number 5,755,850, issued May 26, 1998.

"Infrared Transmitting Glasses with High Glass Transition Temperatures," Steve W. Martin, United States Patent, number 4,492,144, issued July 17, 1990.

XII. RECORDS OF INVENTIONS

"Lithium metal anode and nickel manganese cobalt oxide cathode stable oxy-sulfide Glass," Steve W. Martin, April 3, 2024, ISURF #05711

"Mixed Oxy-Sulfide Solid Electrolytes," Steve W. Martin, February 24, 2016, ISURF #04478.

"Mixed Oxy-Sulfide-Nitride Mixed Network Former Solid Electrolytes," Steve W. Martin, November 2015, ISURF #04451.

"Copper-Alkali Metal Battery, Steve W. Martin, Hao Liu, November 2015, ISURF #04436, affirmative decision January 20, 2016 to process a patent.

"Mid-IR Transparent Glass with an Index of Refraction = 2," Steve W. Martin, Inseok Seo, and Emily Hammel, ISURF Docket number #03846, August 10, 2010.

"Lithium gallium germanium sulfide ($LiGe_2GaS_6$ and other $Li_xGe_yGa_zS_w$) crystals for high power nonlinear optical applications in infrared region," Steve W. Martin, Youngsik Kim, Record of Invention, ISURF docket number 03569, August 28, 2007.

"Development of sulfide glasses as new anode materials for Li-ion batteries," Steve W. Martin, Youngsik Kim, Record of Invention, ISURF docket number 03493, November 21, 2006.

"High Capacitance Density Materials with Low Dielectric Losses Based on Calcium Copper Titanate," David Cann, Steve W. Martin, Eric Patterson, Xiaoli Tan, April 29, 2005, Record of Invention, ISURF docket number 03297**.**

"RF Magnetron Sputtering of Lithium Thiogermanates in Nitrogen Atmosphere," Steve W. Martin, Bryce Campbell, Alan Constant, Record of Invention, ISURF docket number 03195, Filed September 16, 2004.

"Mixed Anion Compounds for Proton Conducting Membranes," Steve A. Poling, Steve W. Martin, Record of Invention, ISURF dockete number 03079, August 29, 2003.

"Environmentally and Electrochemically Stable Ionically Conducting Materials," Steve W. Martin, Jason Saienga, Reconrd of Invention, ISURF docket number 03065, August 1, 2003.

"New Thioborate Crystals for Non-Linear Optical Applications," Steve W. Martin, Young Sik Kim, Record of Invention, June 2003, ISURF docket number 03052, July 1, 2003.

"Synthesis and Uses of Thio Acid," Steve W. Martin, Steven A. Poling, Jacob Sutherland, Record of Invention, ISURF docket number 02894, February 2002.

"Glass-Ceramic Proton Conducting Solid Electrolytes," Steve W. Martin, Renuad Belin, Jacob Sutherland, Record of Invention, ISURF # 02840, July 2001.

"Fast Proton Conducting Chalcogenide Glasses," Record of Invention, Steve W. Martin, ISURF docket number 02553, February 1999.

XIII. UNDERGRADUATE, GRADUATE, and POST-GRADUATE STUDENTS

Ph.D. Degree Students and Dates in Residence:

Keaton Maier, January 2024 - present
Stuart Leland, May 2023 – present
Richeal Oppong, January 2023 – present
Alec Wakefield, January 2023 – present
Victor M. Torres III, August 2020 - present
Jacob Wheaton, May 2020- present
Madison Olson, January 2020 – December 2023
Guantai Hu, November 2017 – December 2022
Katelin Eagan, January 2021 – February 2021, no degree
Devon Schuller, August 2020 – December 2021, no degree
Steven Kmiec, January 2016 – May 2020
Kwang Hyun Kim, August 2015 – May 2020
Melinda Hoyt, June 2015 – May 2018, no degree
Alison Whale, August 2014 – May 2018, no degree
Brittany Curtis, October 2013 – May 2018
Joshua Roth, December 2013 – December 2017
Deborah Watson, August 2012 – December 2017, NSF AGEP Fellowship Awardee, 2012 – 2017,
Emma White, May 2014, NASA Graduate Fellowship Awardee, 2009-2013, NSF Symbi GK-12 Fellowship Awardee, 2013-2014.
Christian Bischoff, May 2013, NSF Symbi GK-12 Fellowship Awardee, 2010-2013
Randilynn Christensen, May 2012, Norbert J. Kreidl Award Winner, 2011
Kristina Lord, August 2008 – June 2009 (no degree)
Austin Shaw, August 2007- May 2008 (no degree)
Inseok Seo, May 2009, Norbert J. Kreidl Award Winner, 2009,
Wenlong Yao, December 2006
Hang Yang Yuen, December 2006
Youngsik Kim, August 2006, Norbert J. Kreidl Award Winner, 2006,

Jason Saienga, December 2005
Chad Martindale, December 2005
Qiang Mei, May 2003
Benjamin Meyer, May 2003
Jeremy Schrooten, December 2001
Cho, Jaephil, May 1995
Hudgens, James, December 1994
Grant, Sheila, August 1994
Patel, Hitendra K., December 1993
Sills, Julia A., December 1993

Thesis M.S. Degree Students and Dates in Residence:

Harold Sandahl, January 2021 – May 2021, No degree
Melinda Hoyt, May 2018 – August 2019, No degree
Mark Anthony Aguilar, May 2018
Peter Enz, December 2017
Bryce Campbell, December 2006
Carly Nelson, August 2006
Youngsik Kim, May 2004
Jacob Sutherland, August 2003
Royle, Michael, December 1999
Shirk, Michael, December 1996
Nithipathrat, Thirachai, December 1995
Kincs, Joseph, August 1994
Van Kirk, Susan, August 1993
Cho, Jaephil, August 1992
Sills, Julia A., November 1990
Shin, Seung Yeop, August 1991
Bloyer, Donald R., May 1990
Patel, Hitendra K., December 1989

Visiting Scientists and Faculty Members:

Ananda Shastri, Department of Physics, Minnesota State University – Moorhead, Moorhead, MN, June – July 2024
Inseok Seo, Division of Advanced Materials Engineering, Jeonbuk National University, February 2023 – July 2024
Ananda Shastri, Department of Physics, Minnesota State University – Moorhead, Moorhead, MN, May – November 2021
Nico Dominik Kohlenbach, Department of Physical Chemistry, University of Muenster, Muenster, Germany, January – April 2019
Fumika Tsuji, Department of Applied Chemistry, Osaka Prefecture University, Osaka, Japan, September – November 2018
Tobias Herring, Department of Physical Chemistry, University of Muenster, Muenster, Germany, September – November 2018
Ananda Shastri, Department of Physics, Minnesota State University – Moorhead, Moorhead, MN, May – June 2018
José Ezequiel De Souza, Professor, UFGD – Federal University of Grande Dourados, Dourados, Brazil, July 2017 – July 2018.
Seila Rojas de Souza, Professor, UFGD – Federal University of Grande Dourados, Dourados, Brazil, July 2017 – July 2018.
Ananda Shastri, Department of Physics, Minnesota State University – Moorhead, Moorhead, MN, May – June 2017
Johannes Betz, Department of Chemistry, University of Muenster, Muenster, Germany, January – May 2016.

Gary DeBoer, Professor Department of Chemistry and Physics, LeTourneau University, Longview, TX, Summer Department of Energy, Visiting Faculty Program, June-August, 2015
Naoto Tanibata, Ph.D. Candidate, Department of Applied Chemistry, Osaka Prefecture University, Osaka, Japan, September – November 2014.
Nerea Mascaraque, Ph. D. Candidate, Instituto de Cerámica y Vidrio (CSIC), Madrid, Spain, September – December 2011
Ic-Pyo Kim, Ph. D. Candidate, Department of Materials Science and Engineering, Gyeongsang National University, Jinju, South Korea, January – February, 2011
Jonas Nordstrum, Ph.D. Candidate, Department of Applied Physics, Chalmers University of Technology, November 2009 – February 2010
Keiichi Minami, Ph.D. Candidate, Department of Applied Chemistry, Osaka Prefecture University, Osaka, Japan, August – September 2009
Dirk Larink, Ph. D. Candidate, Department of Chemistry, University of Muenster, March – August 2009
Tobias Kaufmann, Ph. D. Candidate, Department of Chemistry, University of Muenster, June – August 2007
Math Karlsson, Ph. D. Candidate, Department of Physics, Chalmers University of Technology, August - December 2005
Andrew Burns, Assistant Professor of Chemistry, Kent State University - Stark Campus, NSF Funded, May 1997 - August 1997.
Ranko Rickert, Assistant Professor, Department of Chemistry, Arizona State University, December 2000.

Post-Doctoral Research Associates:

Dr. Guantai Hu, February 2023 -July 2023
Dr. Nicholas Bashian, January 2021 – October 2021
Dr. Steven Kmiec, May 2020 – August 2021
Dr. Ran Zhou, July 2017 – July 2019
Dr. Ryan Gebhardt, April 2017 – January 2019
Dr. Michael Lazar, March 2016 – June 2018
Dr. Shen Li, June 2015 – December 2015
Dr, Yunhua Xu, February 2014 – July 2014.
Dr. Christian Bischoff, June 2013 – October 2013.
Dr. Osama Gaballa, March 2013 – August 2013.
Dr. Hao Liu, July 2012 – May 2015.
Dr. Randilynn Christensen, May 2012 – July 2012
Dr. Inseok Seo, June 2009 – December 2011
Dr. Wenlong Yao, January 2007 – January 2008
Dr. Brito Ferreira, December 2002 – May 2004
Dr. Steven A. Poling, August 2001 – May 2004
Dr. Annamalai Karthikeyan, June 2000 – February 2004
Dr. Jeremy Schrooten, January 2002 – March 2002
Dr. Renaud Belin, August 2000 – August 2001
Dr. Tomoko Akai, March 1997 - February 1998.
Dr. Abdelouahed Soufiane, January 1993 - December 1994
Dr. Wancheng Zhou, August 1991 - August 1993

Research Engineers:

William Fettkether, June 2024 - present
Tara Hoffman, January 2022 – May 2022
Adriana Joyce, January 2020 – June 2020
Brian Fuch, January 2016 – May 2016
Jacob Sutherland, August 2003 – May 2004
Mark Quillin, May 1991-August 1993
Dan Sordelet, August 1992-May 1993

Undergraduate Research Assistants

James Ryckman, May 2024 – present
Summer International Internship, University of Muenster, Muenster, Germany, June – August, 2024
Jayce Abens, January 2024 - present
Nick Tader, January 2024 – present
Isaac Schrooten, January 2024 – present
Junho Lee, January 2024 - present
Azriel Carr, August 2023- present
Cody Lyle, October 2022 – present
Hannah Cochran, December 2022 – present
Chris Martin, October 2022 – present
Barry Goldwater Scholarship Finalist, Fall 2023
Noah Riley, October 2022 – present
Nicholas Oldham, December 2021 – May 2024
Barry Goldwater Scholarship Recipient, Fall 2023 - present
Jordan Ryner, October 2022 – May 2024
William Fettkether, November 2020 – May 2024
Summer International Internship, University of Muenster, Muenster, Germany, June – July 2023
Abigail Schaefer, August 2023 - December 2023
Alexander Pajak December 2021 – August 2023
Presley Phillip, May 2021 – May 2023
Mary Okema, January 2021 – May 2023
Stuart Leland, November 2020 – May 2023
Alec Wakefield, April 2022 – December 2022
Virginia Walker, June 2022 – July 2022
BioMAP NSF REU from Coe College
Kyler Krupp, May 2021 – May 2022
Christopher Sorensen, January 2020 – May 2022
Tara Hoffman, October 2019 – December 2021
Jacob Lovi, March 2018 – May 2021
Harold Sandahl, September 2018 – December 2020
Leah Ells, October 2019 – December 2020
Onel Valdez, March 2018 – May 2019, January 2020 – December 2020
Jacob Wheaton, May 2019 – May 2020
Madison Martin, October 2019 – December 2019
Dmitry Bayko, March 2018 – December 2019
Kah-Hoh Loong, April 2016 – December 2018
Summer International Internship Osaka Prefecture University, Osaka, Japan, May- August 2018
Adriana Joyce, April 2016 – December 2019
Summer International Internship University of Autonoma, Madrid, Spain, May- August 2018
Charles Napier, April 2016 – May 2018
Summer International Internship University of Messina, Messina, Italy, May- August 2017
Brian Fuchs, August 2015 – December 2015
Steven Kmiec, May 2015 – December 2015
Carter Francis, March 2015 – June 2018
Summer International Internship University of Muenster, Muenster, Germany, May- August 2016
Katherine Hakanson, March 2015 – May 2017
Wesley Creighton, March 2013 – May 2015
Jordon Vetter, March 2013 – May 2015,
Summer International REU MEET, University of Muenster, Muenster, Germany, May-August 2014
Ryan Gephardt, May 2012 – August 2012
Summer International REU (Spain) May 2012 – August 2012
Matthew Kielty, Summer REU, June 2012 – August 2012

Chad Maczwieski, January 2012 – May 2013.
Nathan Dunlap, March 2012 – December 2014,
Summer International REU Osaka Prefecture University, Osaka, Japan, Summer, 2014
Maxwell Marple, March 2011 – August 2014,
Summer International REU University of Dortmund, Dorttmund, Germany, Summer 2013.
Jacqueline Kester, September 2010 – August 2011
Emily Hammel, NEMat NSF Summer REU, June – August, 2010
Katheryn Schuller, March 2010 – May 2012,
Summer International REU University of Montpellier, Montpellier, France, Summer 2011.
Lisa Rueschoff, Janaury 2010-present
Malinda Reichert, NEMat NSF Summer REU, June – August 2009
Garrett Olson, January 2009-December 2012
Jack Berkowitz, NEMat NSF Summer REU, June 2008-August 2008
Seth Berbano, January 2008 – May 2011,
2009 Summer International REU Osaka Prefecture University, Osaka, Japan,
2010 Summer International REU Gyeonsang National University
Emily Kuster, June 2007 – December 2008
Michael Haynes, February 2007 – July 2010
Jennifer Byer, August 2006 – May 2009
Andrew Miller, March 2006 – August 2007
Katherine Lawler, January 2005 – August 2007
Andrew Wright, August 2004 – May 2006
Sarah Olson, Augst 2004- May 2006
Kyle Berg, January 2004 – December 2006,
2005 Summer International REU University of Muenster, Muenster, Germany
Melissa Grimsley, August 2001 – December 2005,
2004 Summer International REU Monash, University, Melbourne, Australia
Tim Sklenar, (Freshman Honors Program) January 2004 – August 2005
Jason Walleser, August 2002 – May 2005
Eric Wagner, May 2003 – December 2004
Daniel Palan, August 2002 – December 2004
Bryce Campbell, August 2003 – December 2003
Kelly Lawson, August 2003 – December 2003
Matthew Larsen, August 2002 – May 2003
Micheal Wright, March 2002 – December 2002
Erin Camponeschi – June 2002 – December 2002
Carly Nelson, June 2002 – August 2004
Kelly Lawson, (Freshman Honors Program), January 2002 – August 2002
Daniel Bakken, July 2001 – August 2002
Jason Thomas (Freshman Honors Program), January 2001 – May 2001
Crystal Castro, August 2000 – January 2002
Jessica Kness, June 2000 – December 2000
Chad Martindale, June 1999 – May 2001
Jason Saeinga, June 1999 – December 2001
Kari Salveson, August 1999 – May 2000
Melissa Giegerich (Freshman Honors Program), January – May 2000
Paul Tomlinson (Freshman Honors Program), January – May 1999
Nathan Roller (Freshman Honors Program), January - May 1998
Jane Clayton, May 1997 - October 1997
Sarah Kowalcyzk, May 1997 – May 1998
Liap Su, October 1996 - October 1997
Aron Butler, September 1996 – December 1999
Jeremy Schrooten, January 1996 - May 1997
James Reinig, May 1996 - May 1997
Eric Johnson, October 1996 - May 1997
Jim Stevenson, October 1996 - December 1996
Eric Summers, December 1995 - August 1996

Jesse Huebsch, December 1995 - August 1996
Eric Busler, December 1995 - August 1995
Dan DeKruif, August 1995 - May 1996
Clark Weber, May 1996 - August 1996
Tara Utesch, January 1995 - May 1995
Sara Anderson, May 1993 - December 1993
Kirk Garrett, December 1991 - December 1994
Stephen Orada, February 1994 - December 1995
Tara Smith, August 1993 - December 1995
Jim Hudgens, May 1989 - June 1990
Mark Wagner, May 1988 - May 1989

Women in Science & Engineering High School Summer Interns

Jennifer Byer, Summer 2004
Katherine Lawler, Summer 2003
Jessica Koschmeder, Summer 2002
Brenda Lauterbach, Summer 2001
Ashley Martin, Summer 2000
Melissa Grimsley, Summer 2000
Katherine Smirl, Summer 1999
Rachel Hadaway, Summer 1998
Rachel Neuendorf, Summer 1997
Sarah Allen, Summer 1996
Cami Nepple, Summer 1995
Erin Eckert, Summer 1994
Stacey Nalean, Summer 1993
Sara Rolfe, Summer 1992

XIV. PROFESSIONAL ACTIVITIES

Professional Society Memberships:

American Ceramic Society
- Glass & Optical Materials Division
- Energy Materials and Systems Division
- Ceramic Education Council
- Keramos, Professional Ceramic Engineering Fraternity
- National Institute of Ceramic Engineers

Electrochemical Society
Materials Research Society American Society for Engineering Educators
- Materials Division

Sigma Xi
Corning Museum of Glass
International Society for Solid State Ionics
Osborn Research Club
Non-Oxide Glass Society

Professional Society Offices and Committees:

International Commission on Glass, Technical Committee 03, “Structure of Glass,” Committee Member, April 2018 – present.
Sigma Xi, Director of Comprehensive Colleges and Universities Constituency, December 2015 – June 2022.
Sigma Xi, Executive Board Member, December 2015 – June 2022.
Sigma Xi, Executive Committee Member, ISU Chapter, August 2015 – June 2022.

Member, International Organizing Committee, 3rd International Meeting on Phosphate Materials, Corning, NY, July 2023

Member, International Organizing Committee, 2nd International Meeting on Phosphate Materials, Oxford, England, July 2017

Member, International Organizing Committee, 24th International Congress on Glass, Shanghai, China, April 2016

Co-Chair, Glass and Optical Materials Division programming at the 119th Annual Meeting of the American Ceramic Society combined with the Materials Science and Technology October 2017, Pittsburgh, PA.

Chair, Glass and Optical Materials Division programming at the 118th Annual Meeting of the American Ceramic Society combined with the Materials Science and Technology 2016, Salt Lake, City, UT.

Co-Chair, 2nd Annual Joint Meeting of the Glass and Optical Materials Division of the American Ceramic Society and the 89th Annual Meeting of the German Glass Science and Technology Society, Miami, FL, 2015.

Chair, 1st Annual Joint Meeting of the Glass and Optical Materials Division of the American Ceramic Society and the 88th Annual Meeting of the German Glass Science and Technology Society, Aachen, Germany, 2014.

Member, International Organizing Committee, 1st International Meeting on Phosphate Materials, Prague Czech Republic, July 2014

Member, International Advisory Board, CeRTEV, Center for Research, Technology and Education in Vitreous Materials, Department of Materials Engineering, Federal University of São Carlos, August 2013 – present.

Member, International Review Committee of the Materials and Optics Laboratory, Université de Rennes 1 - Campus de Beaulieu, University of Arizona, May 2011 – October 2012.

President Emeritus, Sigma Xi, ISU Chapter, May 2011-April 2012

President, Sigma XI, ISU Chapter, May 2010-April 2011

President-Elect, Sigma XI, ISU Chapter, May 2009 – April 2010

Chair, Glass and Optical Materials Division of the American Ceramic Society, October 2010 – October 2011.

Chair-Elect, Glass and Optical Materials Division of the American Ceramic Society, October 2009 – September 2010.

Co-Chair, Glass and Optical Materials Division and 8th Pacific Rim Conference on Ceramic and Glass Technology, Symposium 26: Honorary Symposium Recognizing 75th Birthday of Professor C. Austen Angell, October 2009

Chair, Alfred R. Cooper Distinguished Lecturer and Young Scholars Awards, Glass and Optical Materials Division of the American Ceramic Society, May 2007 – present

Secretary, Glass and Optical Materials Division of the American Ceramic Society, June 2007- June 2008.

Co-Chair, Glass and Optical Materials Division and 18th University Conference on Glass, Symposium 5: Honorary Symposium Recognizing the Lifelong Achievements of Professor Cornelius T. Moynihan, Rochester, NY May 20-23, 2007

Member of the International Organizing Committee, "International Conference on Inorganic Glasses with Special Properties and Uses," Bangalore, India, April 2006

Co-Chair, Joint Meeting of the International Society of Non-Oxide Glasses and the Fall Glass and Optical Materials Division of the American Ceramic Society, Coco Beach, FL, November 2004.

Co-Chair, 15th University Conference on Glass Science, "Structure, Properties and Applications of Phosphate and Phosphate Containing Gasses", Rolla, MO, June 1999.

Chair, Rules Committee, Glass & Optical Materials Division, American Ceramic Society, 1993 - 2010. I totally rewrote and modernized the division's operations manual which had not been revised since the early 1980s.

Member, Program Committee, Glass & Optical Materials Division, American Ceramic Society, 1993 – 1999.

Chairman, Statistics Committee, Ceramic Education Council, American Ceramic Society, 1989-1999.

Chair, Annual Meeting of the American Ceramic Society, Glass and Optical Materials Division, Cincinnati, OH, April 1998

Chair, Working Group on Glass and Optical Materials, National Science Foundation- Division of Materials Research, Ceramics Program Workshop on "Fundamental Research Needs In Ceramics", June 1997.

Chair, Fall Meeting of the Glass and Optical Materials Division of the American Ceramic Society, San Antonio, TX, November 1996
Symposium Chair, “Intermediate Range Order in Glass,” Fall Meeting of the Glass and Optical Materials Division of the American Ceramic Society, San Antonio, TX, November 1996
Chair, Gordon Conference on Solid State Ionics, June 1996
Symposium Chair, "Glass and Ceramic Structure by Spectroscopy", 97th Annual Meeting of the American Ceramic Society, Cincinnati, OH April 1995
Co-Chair Gordon Conference on Solid State Ionics, June 1994
Symposium Chair, Ceramic Education Council, "Ceramic Education Symposium," 96th Annual Meeting of the American Ceramic Society, Cincinnati, OH April 1994
President, 1993-94, Ceramic Education Council, American Ceramic Society
Member, Education Committee, American Ceramic Society, 1994-1998.
President-elect, 1993-1994, Ceramic Education Council, American Ceramic Society, Vice-president elect 1992-93, Treasurer 1991-92, and Secretary 1990-91
Member, Membership Committee, Glass & Optical Materials Division, American Ceramic Society, 1990-92
Member, Short Course Committee, American Ceramic Society, 1989-92

Professional Service:

Co-principal investigator for NSF funded, $170,000/year, "Research careers for minority scholars program." This project seeks to increase the number of minorities who attain Ph.D.'s in engineering. So far over twenty minorities have graduated from our program and attended graduate school in engineering. May 1993 – May 1998.

Program participant, ISU's Program for Women in Science and Engineering. I have supported a high school junior girl to work in my research laboratory on glass research projects. So far, of fourteen girls who I have supported, all but one has gone on to a college or university to attain a degree in science or engineering. Of the past three women, all are attending ISU and majoring in Ceramic Engineering (2) and chemical engineering, May 1992 – August 2004.

Consulting:

Active:

Kellogg, Hansen, Todd, Figel & Frederick, P.L.L.C., Expert witness on matters pertaining to display glasses, March 2024 -present
Kilpatrick, Townsend & Stockton, LLP, Expert witness on matters pertaining to glass tempering, October 2023 – present.
RJ Technology LLC, Expert witness on matters concerning Lithium ion batteries, April 2023 – present.
Group 14 Technologies, Inc., Expert witness on matters concerning Lithium ion batteries, April 2023 – present.
Faraci Lang Attorneys, Expert witness on various matters concerning Lithium ion batteries, March 2023 – present.
Highlands Advisory LLC, Expert witness on various matters pertaining to batteries, September 2022 – present.
Jupiter E-Power, Independent advisor on matters pertaining to Lithium-ion batteries, August 2022 – present.
Simon Law Form, P.C., Expert witness on matters pertaining to solar cells, April 2022 – present.

Completed:

Quinn Emanuel LLC, Expert witness on matters concerning Lithium ion batteries, May 2023 – May 2024.
Wilmer Cutler Pickering Hale and Dorr LLP, Expert witness on matters pertaining to ion exchanged glass, November 2019 – December 2022.
Nielsen Law Firm, Expert witness on matters pertaining to glass failure, June 2022 – February 2023.
Winston & Strawn LLP, Expert witness on matters pertaining to foldable glass, February 2020 – August

2022
Greenspoon Marder LLP, Expert Witness on matters pertaining to glass failure," January 2019 – April 2022
Bolt Hoffer Boyd Law Firm, "Expert Witness on Material Failure," December 2018 – November 2021.
Robert F. Danzi Law Firm, "Expert Witness on Glass Failure, November 2018 – August 2019.
Robins and Kaplan LLP, Expert witness on Lithium Battery Anode Materials, December 2019-December 2020
Harbin & Burnett, LLP, "Expert Witness on Glass Failure," August 2018 – August 2019.
PolyPlus Battery Company, Berkeley, CA, "Preparation of New Chemically Stable Fast Li^+ Ion Conducting Glasses," December 2014 – August 2019.
Tom Riley Law Firm, P.L.C., "Expert Witness on Glass Bottle Failure," May 2018 – December 2019.
Jonah Grossman Law Firm, "Expert Witness on Glass Vial Failure," August 2018 – December 2019.
Leader, Bulso & Nolan, PLC, "Expert Witness on Glass Panel Failure," May 2018 – September 2018.
Holland and Knight, LLP, Chicago, IL, "Expert Witness on Fiber Glass," December 2016 – May 2018
Currie & Liabo Law Firm, PLC, Cedar Rapids, IA, "Expert Analysis on Lithium Batteries," December 2015 – May 2017.
Shook Hardy, and Bacon, LLP, Kansas City, KS, "Expert Witness on Automotive Tempered Glass Panels," January 2017- May 2017
Goldsten and Gragel Law Firm, LLC, Cleveland, OH, "Expert Analysis on the Melting of Silica Glass," August 2015 – August 2016.
Susman Godfrey LLP, New York, NY, "Expert Analysis on the use of Mixed Color Glass Cullet in Glass Manufacturing," December 2014-May 2017.
Oblon, Spivak, McClelland, Maier & Neustadt, L.L.P., Washington, D.C., "Expert Analysis of Patents and other Matters Relating to Chemically Strengthened Glass," November 2014 – May 2017.
Lubrizol Corporation, Cleveland, OH, "Dielectric Spectroscopy Measurements of Plastics from 1 Hz to 3 GHz," September 2012 – December 2015.
Hach Chemical Company, Ames, IA, "Chemical Analysis of Glass Composition," March 2014.
United States Department of Justice, New York, New York, "Expert Report on Lanthanum Oxide and its Common Impurities," December 2013 – February 2014.
Guardian Industries, DeWitt, IA, "Evaluation of Glass Composition," June 2013.
Portnoy and Quinn, LLC, Pittsburgh, PA, "Examination of Bottle Glass Failure," March 2013 – August 2013.
QuantumScape Corporation, San Jose, CA, "Development and Characterization of Sulfide-Based Li^+ Ion Conducting Thin Film Solid Electrolytes, February 2013 – August 2013.
SEEO Corporation, Hayward, CA, "Development of new Sulfide-based Solid Electrolytes for Lithium Batteries," June 2011 – June 2013.
Templeton Rye Whiskey LLC, Templeton, IA, "Examination of Bottle Glass Failure," June – September 2012.
Owens-Corning Fiber Glass, "Examination of the IR absorbance of Fiber Glass and Dopants to Affect Same," August 2011 – July 2013.
Guardian Industries, DeWitt, IA, "Evaluation of Glass Defect," August 2011.
Guardian Industries, DeWitt, IA, "Evaluation of Glass Composition," September 2011.
Schott AG, Research and Development Center, Mainz, Germany, "Melting Under Controlled Atmosphere Conditions," September 2011.
Siemens Industry, Inc., Ames, IA, "Infrared and Raman Spectral Analysis of Various Hallow Fiber Filter Materials," April – July 2011.
Climax-Molybdenum, Ft. Madison, IA, "Analysis of Various MoO_3 Materials and Basic Filtrants and Filtrates therefrom," August 2010 – July 2011.
Clemson University, "Glass Composition Development for Semiconductor Core – Glass Clad Optical Fibers, January 2011 – Juky 2013.
Guardian Glass, DeWitt, IA, "Analysis of White Residue on Tempered Glass Sheets," July 2010.
Amco Insurance Company, Des Moines, IA, "Invesitgation of Fogged Residence Insulated Glass Windows," April 2009.
Lubrizol, Westlake, OH, "Impedance Spectroscopy of Various Oils," February 2009 – September 2012.
Clemson University, Clemson, SC, "Cladding Glass Composition Development for Laser Optical Fibers," January 2009 - December 2010.

Schott AG, Research and Development Center, Mainz, Germany, "Glass Composition and Property Review for Application in Lithium Batteries," December 2008 - December 2010.
MaxPower, Inc., Philadelphia, PA, "Fast Ion Conducting Glass Composition Development for Lithum Batteries," January 2009 - December 2010.
Tom Zarley Law Firm, Des Moines, IA, "Examination of and report on patents and other matters pertaining to laminated glass panels," January 2008 – December 2008.
Owens-Corning Fiber Glass, Granville, OH, "Measurement and Characterization of the Frequency and Temperature Dependence of the Dielectric Properties of Various Glasses," May 2007 – March 2010.
Tom Zarley Law Firm, Des Moines, IA, "Characterization of Glass Tiles and Method of Manufacturer," May – June 2007.
Amco Insurance Company, Des Moines, IA, "Invesitgation of Fogged Residence Insulated Glass Windows," November – December 2005.
Hach Corporation, Ames, IA, "Qualifying New Glass Products," February - August 2005.
Climax-Molybdenum, Fort Madison, IA, "Raman spectroscopy of Molybdenum oxide phases," May 2002 – December 2010.
Bradshaw, Fowler, Proctor & Fairgrave, P.C. Law Firm, Des Moines, IA, "Evaluation of the Corrosion of Residential Window Glass," January – December 2004.
Kohler Corporation, Kohler, WI, "Development and Characterization of Low Expansion Easily Metled Silicate Glasses," June 2003 – August 2004.
Han Furniture, Muscatine, IA, "Fire testing of fireproof coatings on sheet metal," June – December 2002.
Guardian Industries, Inc., DeWitt, IA, "Short Course on the Structure and Properties of Silicate Glasses," July 2002.
Sauer-Sundstrand, Ames, IA, "Identifcation of Rubber Seal Materials," May 2001 – August 2002.
Northstar Glassworks, Seattle, WA, "Litigation concerning infringement of trade secrets concerning glass manufacturing," December 2001 - December 2002.
GNB Industrial Power, Lombard, IL, "Analysis of Glass Mat Materials for Use in Lead Acid Batteries," June – July 2001.
Eclipse Surgical Technologies, San Jose, CA, "Catastrophic Fracture and Failure of Transmyocardial Revascularization Lenses," July 2000.
Eclipse Surgical Technologies, San Jose, CA, "Surface Defects in Transmyocardial Revascularization Lenses," May 2000.
Field Museum of Natural History, Chicago, IL, "Glass: A Miracle Material - A short course on the mechanical properties of glass," June 2000. Guardian Industries, Inc., DeWitt, IA, "Analysis of Float Glass Surface Coatings," June – December 1999.
E-Tek Dynamics, San Jose, CA, "Short Course on Glass Science and Engineering," June – August 1999.
Cardiogenesis Incorporated, Sunnyvale, CA, "Analysis of Transmyocardial Resection Lense Defects," June 1997 – December 1999.
Norand Corporation, Cedar Rapids, IA, "Low Load Failures in Touchscreen Glass Panels," January 1997 – December 1998.
Gemini 8-M Telescopes Project, Tucson, AZ, "Analysis and Characterization of Blue Seal Plane Problem," August 1996 – December 1998.
Tom Riley Law Firm, Cedar Rapids, IA, "Expert witness on glass chemistry to analyze composition of baby food glass jars," January - December, 1988.

XV. UNIVERSITY ACTIVITIES

Faculty Senate:

MSE Faculty Senator, August 1992-May 1996

University Committees:

Iowa State University, Graduate College, Faculty Evaluation Committee for AGEP and GWC Fellowships, January 2013 – December 2017.
Iowa State University, Distinguished Professor Committee, February 2013 – December 2015

Iowa State University, University Professor Committee, January 2008 - 2011
Iowa State University Faculty Senate Research Committee, July 2008 – June 2010
Iowa State University, Graduate College Diversity Council for AGEP, Alliance for Graduate Education and the Professoriate, July 2008 – Deecember 2015.
University Library Committee, August 2000 – August 2005
Faculty Senate Committee to Review Crisis in Scholarly Publication, June 1998 – December 1999.
Chair, Task Force to Review University Shops, March 1997 - November 1998.
Graduate Program of Study Review Committee, 1990-1991
University Awards Committee, 1992

College Committees:

College of Engineering, Diversity and Inclusion Committee, November 2020 – present.
College of Engineering, Energy Minor Working Group, August 2010 – present.
College of Engineering, Student Innovation Center Working Group, January 2012 - 2013
College of Engineering, Chair, Distinguished Professor Review Committee, December 2009-2012
College of Engineering, University Professor Committee, January 2008 - 2011
College of Engineering, Promotion and Tenure Committee, November 2008
College of Engineering, Graduate Research Task Force, July 2007 – June 2008.
College of Engineering, Committee on Diversity, August 2005 – June 2009.
College of Engineering, MSE Department Chair Search Committee, October 2005 – December 2005.
College of Engineering, Research Committee, August 2003 – July 2008.
Department of Chemical Engineering Chair Review Committee, Chair, December 2001 – June 2002.
College of Engineering Research Committee, 1992-2002
College of Engineering Extension Committee, 1990-1992
College of Engineering Ad Hoc Committee for Evaluation and the Review of the Department of Chemical Engineering, November 1989 - January 1990
College of Engineering Ad Hoc Dean's Advisory Committee for College Reorganization, January 1989 - May, 1989
College of Engineering Educational Relations, 1988 – 90
College of Engineering Seminar Committee, 1987 – 90

Departmental Committees:

MSE Promotion and Tenure Committee, Chair, August 2022 – present
MSE Working Group on Ceramics Curricula, June 1997 - present.
MSE Seminar Committee, co-Chair, July 2015 – May 2023
MSE Faculty Search Committee, January 2021 – May 2022
MSE Faculty Search Committee, September 2018 – May 2019
MSE Safety Committee, Faculty Chair, July 2017 – May 2019
MSE Ceramics Faculty Search Committee Chair, June 2015 – February 2016.
MSE Promotion and Tenure Committee Chair, August 2013 – May 2017
MSE Major Research Initiatives Committee, August 2012 – May 2013.
MSE Graduate Studies Committee, August 2012 – May 2013
MSE Post-Tenure Review Sub-Committee Chair, January – October 2012
MSE Faculty Search Committee, Chair, September, 2010 – April 2011.
MSE Graduate Studies Committee Chair, August 2007 – July 2008.
MSE Facilities and Equipment Committee, Chair August 2003 – June 2006.
MSE Undergraduate Student Affairs Committee, August 2003 – June 2006.
MSE Promotion and Tenure Committee, July 1996 - present
MSE Facilities and Equipment Committee, Chair, July 1998 – May 2003
MSE Computer Committee, June 1998 – June 2002.
MSE Computer Committee, Chair, October 1996 – June 1998.
MSE Departmental Executive Officer Search Committee, April 1996 - December 1996.
MSE and Chemical Engineering Ad Hoc Committee on Merging the two departments, October - December 1995.
MSE Ad Hoc Committee on Undergraduate Recruitment October 1995 - October 1997.

MSE Ad Hoc Committee on Wireless Local Area Network Development, Chair, March 1995 - December 1996.
MSE Undergraduate Advisor, October 1995 – May 1999.
MSE Library Liason, July 1995 – present.
MSE Facilities, Equipment, and Computer Committee, Chair, Spring 1992-October 1996.
MSE Ad Hoc Committee for New Faculty Search, 1990.
MSE Ad Hoc Extended Facilities Committee, 1990.
MSE Graduate Recruitment, Admissions and Assignment Committee, 1988-1992.
MSE Seminar Committee, 1986-87; Chair, 1987-88; Co-Chairman 1988-1991.
MSE Ad Hoc Committee for Computer Planning, 1987-1992.

Other

MSE Faculty Advisor Gaffer's Guild, a student organization in glass blowing art, science and engineering, October 1994 – present

XVI. OTHER INFORMATION

Collaborations:
Active:

"Mechanical, Electrical, and Electrochemical Studies of Fast Ion Conducting Glasses," Oak Ridge National Laboratory, May 2022 – present, 3 publications, 1 publication in preparation

"Measurement of Spin-lattice relaxation Times in Ion Conducting Glasses," Minnesota State University at Moorhead, May 2017 – present, 2 publications, 1 publication in preparation.

"Structural Studies of Glasses Densified at Room Temperature and at Elevated Temperatures," Department of Physics, University of Messina, Messina, Sicily, Italy, January 2012 – present, no publications.

"Preparation and characterization of alkali borate, alkali borosilicate, and alkali borogermanate glasses" Professors Steve Feller, Ciao Bragatto, Coe College, September 1984 - present, 12 publications.

Completed:

"Preparation and Characterization of Thin Film and Bulk Nitrided Alkali Phosphate Glasses," Institute of Ceramics and Glass, University of Madrid Autonomo, Madrid, Spain, August 2011 – December 31, 2022, no publications.

Preparation and Characterization Fast Ion Conducting Solid Electrolytes," Professor Masahiro Tatsumisago, Osaka Prefecture University, Osaka, Japan, May 2010 – December 31, 2022, one publication.

"Spin Lattice Relaxation Rate Measurements of Fast Ion Conducting Solid Electrolytes," Professor Michael Vogel, Technische Universität Darmstadt, Darmstadt, Germany, July 2011 – December 2020, 2 publications.

"Development of New All Solid State Sodium Batteries," University of Houston, Univerity of Colorado at Boulder, Washington State Univerity, Solid Power, Inc., May 2015 – May 2019.

"Preparation and Characterization of Sodium BoroSilicate Glasses," Rutgers University, Corning Incorporated, Coe College, University of North Texas, University of Michigan, January 2015 – May 2019.

"NMR studies of ion dynamics in ternary glassy systems: Mixed Glass Former Effect in Ion Conducting Glasses," Professor Roland Bohmer, Technische Universität Dortmund, Dortmund, May 2011- December 2017, 1 publication.

"Development of New Lithium Batteries," Muenster Electrochemical Energy Technology Center, University of Muenster, Muesnter, Germany, June 2012 – December 2017, no publications.

"Room temperature Sodium Batteries," Professor Hyo-Jun Ahn, School of Materials Science and Engineering, Gyeongsang National University, Korea, January 2011 – December 2017, 1 publication.

"Mixed Glass Former Effect on the Properties of Glass," Professor Philipp Maass, University of Osnabruck, Osnabruck, Germany, August 2007 – December 2017, 5 publications

"Preparation of New Chemically Stable Fast Li^+ Ion Conducting Glasses," PolyPlus Battery Company, Berkeley, CA, December 2014 – May 2017.

"Cs^+ Ion Conducting Glasses," Draper Laboratories, May 2014 – December 2016, 1 publication.

"New Li^+ Ion Conducting Solid Electrolytes," Honda Research Corportation of America, January 2015 – December 2016, no publications.

"Rubidium Containing Sulfide Glasses," Université du Littoral Côte d'Opale (ULCO), Dunkerque, France, August 2014 – July 2016.

"Solid State Electrolytes for New Solid State Lithium Batteries," SEEO, Incorporated, March 2012 – June 2013, no publications.

"Preparation and Characterization of New Sulfide-Based Chalcogenide Mixed Glass Former Glasses," University of Montepellier–II, Montepellier, France, January 2012 – June 2013, no publications.

"Preparation of Mixed Oxy-Sulfide Li^+ ion Conducting Glasses," Schott AG, Research and Development Center, Mainz, Germany, March 2012 – July 2013, no publications.

"Aero-Sol Spray Deposition of Solid State Lithium Batteries," Dr. Dong-Soo Park, Korean Institute of Materials Science, Changwon, Korea, March 2012 – July 2013, no publications.

"^{1}H NMR Analysis of Alkali Metal Thiohydroxymetallates," Professor Ananda Shastri, Deparrtment of Physics, University of Minnesota – Moorhead, Moorehead, MN, January 2010 – July 2013, 1 publication.

"High Permittivity Glasses and Glass Fibers Drawn from for High Energy Density Capacitors," Enis Tuncer, Division of Materials Science and Engineering, Oak Ridge National Laboratory, June 2009 – April 2011, no publications.

"Preparation and Characterization of Various Solid State Li-ion Batteries and Materials for Such," Chris Rhodes, LYNNTECH, Inc, College Station, TX, January 2010 – August 2011, no publications.

"Mixed Glass Former Effect on the Properties of Glass," Professsor Valeri Petkov, Central Michigan University, Professor Ruediger Dieckmann, Cornell University, Professor Aleksandar Matic, Chalmers University of Technology, Gothenburg, Sweden, Professors Klaus Funke, Hellmut Eckert, Munster University, Munster, Germany, Professor Philipp Maass, Ilmenau University, Ilmenau, Germany, August 2007 – July 2011, 6 publications

"Field Cycling T1 Measurements of Fast Ion Conducting Glasses," Professor Franz Fujara, Department of Physics, Technical University of Darmstadt, Darmstadt, Germany, January, 2007 – December 2009, no publications.

"Preparation and Characterization of New Chalcogenide Glass Anode Materials for High Energy Density Secondary Rechargeable Lithum Batteries, Professor Jaephil Cho, Department of Applied Chemistry, Kumoh University, Gigi, Korea, May 2005 –December 2009, 3 publications.

"Differential Scanning Calorimetry Studies of the Bulk Metallic Glass Transition Relaxation Kinetics," Dr. Dan Sordelet, Materials Engineering and Physics Program, Ames Laboratory, August 2003 – December 2007, 1 publication.

"Multi-Dimensional ^{1}H NMR Spectroscopy of Hyrdrated Alkali Thio-Hyrdoxometallates," Professor Klaus Schmidt-Rohr, Department of Chemistry, Iowa State University, August 2004 – December 2009, no publications.

"Space Charge Polarization Measurements in Fast Ion Conducting Glasses," Professor Klaus Funke, Department of Physical Chemistry, University of Muenster, Muenster, Germany, 2004- 2007, 1 publication.

"Structure and Dynamics of Fast Proton Conducting Sulfide and Oxy-Sulfide Glasses and Ceramics," Professor Lars Borjesson, Dr. Aleksandar Matic, Department of Applied Physics, Chalmers University of Technology, January 2004 – January 2010.

"^{2}D and ^{1}H NMR Spectroscopy of Fast Proton Conducting Sulfide and Oxy-Sulfide Glasses and Ceramics," Professor Roland Bohmer, Professor Otmar Kanert, Department of Physics, Dortmund University, January 2004 – 2007, 1 publication.

"X-Ray Scattering Studies of the Structures of Alkali and Silver Thiborate and Thiogermanate Glasses," Professor Dr. Valeri Petkov, Department of Physics, Central Michigan University, October 2003 – August 2007, 1 publication.

"Evaluation of the Optical and Electrical Properties of Oxy-chalcogenide Glass Materials," Professor Kathleen Richardson, University of Central Florida, Professor Himanshu Jain, Lehigh University, Professor Thierry Cardinal and Phillippe Vinetier, Univesity of Bordeaux, Professor Alan Constant, Iowa State University, August 2002 – December 2007.

"^{1}H NMR Studies of Fast Proton Conducting Chalcogenide Glasses," Professor Steven Greenbaum, Hunter College, CUNY, New York, New York, October 1999 – December 2007.

"Thin-Film Chalcogenide Electrolytes for Thin-Film Lithium Batteries," Dr. Phillippe Vinetier, Department of Solid State Chemistry, University of Bordeaux, Bordeaux, France, June 2002 – July 2008.

"Preparation and Characterization of High Temperature Highly Conducting Glasses," Dr. William West, Jet Propulsion Laboratory, Pasadena, CA, September 2002 – October 2005.

"Elaboration and characterization of oxysulfide glass in the Ge - Sb - B system", Dr. Laeticia Petit, Clemson University, Center for Optical Materials Sceince, Engineering, and Technology, May 2003 – August 2004, 1 publication.

"Second Harmonic Generation measurements of Crystalline Heavy Metal Thioborate compounds," Professor Shiv Halasymani, Department of Chemistry, University of Houston, August 2002 – August 2004 1 publication.

"^{109}Ag High Magnetic Field NMR Studies of Fast Ion Conducting Silver Thio-borosilicate glasses," Dr. Zhehong Gan, National High Magnetic Field Research Laboratory, Tallahassee, Florida, January 1999 – August 2004.

"Glassy FIC Electrolytes for Use in Lithium Polymer Batteries," Dr. Steve Visco, Lawrence Berkeley Laboratory and PolyPlus Inc., August 1996 – August 2004, no publications.

"Ionic Hall Effect Measurements of Fast Ion Conducting Chlacogenide Glasses," Dr. Bruce Cook, Materials Engineering and Physics Program, Ames Laboratory, November 2003 – Janaury 2005.

"Glassy FIC Electrolytes for Use in High Temperature Lithium Polymer Batteries," Franz Ooms, University of Deflt, The Netherlands, August 2002 – December 2002, no publications.

"Preparation and Characterization of New Lithium Ion Conducting Glasses," Prof. E.M. Kelder, Delft University of Technology, Delft, Denmark, September 2002 – December 2003.

"High Pressure Crystalliazation Studies of Vitreous Boron Trisulfide," Professor Paul McMillan, Arizona State University, Tempe, Arizona, January 1999 - December 2000.

"Analysis of Fast Ion Dynamics in Chalcogenide Glasses," Professor Ivar Svare, Trondheim University of Sciecne and Technology, Trondheim, Norway, January 1993 – December 2002, seven publications.

"Structures and Properties of Anhydrous Binary Alkali Phosphate Glasses," Professor Richard Brow, University of Missouri - Rolla, Rolla, MO, June 1998 – August 2002, no publications.

"High Resolution MASS NMR Studies of Anhydrous Alkali Ultraphosphate Glasses," Dr. Todd Alam, Sandia National Laboratory, Albuquerque, NM, January 1998 – December 1999, no publications.

"Neutron Diffraction Studies of Structure and Dynamics in Fast Ion Conducting Glasses", Lars Borjesson, Lena Torell, Department of Physics, Chalmers University of Technology, January 1997 – August 2002, 3 publications.

"NMR studies of glass structure," Dr. Marek Pruski, Ames Laboratory, August 1994 – August 2001, 2 publications.

"Preparation and characterization of anhydrous binary alkali phosphate glasses," Dr. Richard Brow, Sandia National Laboratory, Albuquerque, NM, September 1989 - June 1998, 2 publications.

"Neutron diffraction studies of inorganic glasses," Dr. Adrian C. Wright, J. J. Thompson Laboratory, Whiteknights, Reading, U.K., Dr. Roger N. Sinclair, Materials Physics and Metallurgy Division, Harwell Laboratory, Chilton, Didcat, U.K, March 1989-2006, 4 publications.

"Multi-nuclear NMR studies of fast ion conducting glasses," Professor Ferdinando Borsa, Department of Physics and Ames Laboratory, August 1988 - Decembert 2008, 21 publications

"Neutron scattering studies of glasses," Dr. David Price, Argonne National Laboratory, May 1993 - December 1998, 1 publication.

Raman Spectroscopy of Alkali Thioborate Glasses and Polycrystals", Therese Cotton, Chemistry Department, Iowa State University, May1994 - December 1998, 1 publication.

"Low Temperature Heat Capacity Measurements of Alkali Thioborate Glasses", Professor Edgar Westrum, University of Michigan, August 1994 - December 1998, no publications.

"Ultrasonic attenuation and low temperature heat capacities studies of new alkali thioborate glasses," Professor Guiseppe Carini, University of Messina, Messina, Italy, September 1990-December 1994, no publications.

"High field, high spinning rate B MASS-NMR studies of alkali thioborate glasses," Dr. Hellmut Eckert, Department of Chemistry, University of California at Santa Barbara, Santa Barbara, CA, September 1990 - December 1994, no publications.

"Nuclear quadruple resonance (NQR) studies of alkali thioborate glasses," Professor Philip Bray, Department of Physics, Brown University, Providence, RI, September 1990-December 1996, no publications.

"Preparation and characterization of new superionically conducting selenide glasses," Drs. Michel Ribes and Annie Pradel, Laboratoire De Chemie Minerale C, Universite De Montpellier, Montpellier, Cedex, France, July 1988-January 1993.

"Wide frequency range investigations of the dynamics of fast ion conduction in glass," Dr. Lena M. Torrell, Professor of Physics, and Professor Lars Borjesson, Department of Physics, Chalmers University of Technology, Gothenburg, Sweden, October 1984 - December 1996, 4 publications.

"Multinuclear NMR Investigations of fast ion conduction in glass," Dr. Detlef Brinkmann, Professor of Physics, Physik - Institut, Universitat Zurich, Zurich, Switzerland, October 1984 - December 1990, one publication.

"Preparation and characterization of new AgI-doped Ag-Oxysalt glasses solid electrolytes," Dr. Alberto Schiraldi, Professor of Chemical Physics, Department Di Chimica Fisica, Universite' de Pavia, Pavia, Italy, two publications, September 1983 - December 1985, 2 publications.

Refereeing or Editorial Assignments, Reviewing of Research Proposals:

Referee, 1994 - present, Physics and Chemistry of Glasses
Referee, 1990 - present, Journal of Physical Chemistry
Referee, 1988 - present, Journal of Non-Crystalline Solids
Referee, 1987 - present, Journal American Ceramic Society
Referee, 1987 - present, Solid State Ionics
Referee, 1987 - present, Journal Physics and Chemistry of Solids

Referee, 2002 – 2006, Journal of Alloys and Compounds
Referee, 1999 - 2007, Materials Research Bulletin
Referee, 1996 - 2008, Journal of Chemical Physics
Referee, 1991 - 2009, Physical Review
Referee, 1989 - 1996, Journal of Applied Physics
Referee, 1984 - 1994, Journal Solid State Chemistry

Reviewer, 2013 – present, National Science Foundation, Division of Chemistry
Reviewer, 2006 – present, National Science Foundation, Division of Graduate Education
Reviewer, 2003 – present, AFOSR, Materials Science and Engineering Program
Reviewer, 2000 – present, U.S. Civilian Research and Development Foundation (CRDF)
Reviewer, 1999 - present, NASA Materials Science and Engineering Program
Reviewer, 1993 - present, Department of Energy, Division of Materials Science
Reviewer, 1988 - present, National Science Foundation, Division of International Programs
Reviewer, 1987 - present, National Science Foundation, Division of Materials Research
Reviewer, 1990 - 1994, Petroleum Research Fund, Research Grants Program

EXHIBIT B – LIST OF REFENCES

1. HP 6-Cell battery Specification for MU06062, Rev. 1.3, 2009/12/09, HP01378-HP01389.
2. LG Chem Specifications for Approval Version A11, 12 Nov. 2013, HP01297-HP01334.
3. HP Answers to Plaintiffs' Third Set of Interrogatories.
4. Deposition testimony of David Pipho, August 7, 2024.
5. Texas Instruments Application Report, SLUA346A – July 2005
6. CT Imaging of Laptop
7. Specification for TI bq2060A Gas Gauge
8. Deposition testimony of Lee Atkinson
9. Technical Reference for Texas Instruments bq20z40/bq20z45, 2006;
10. Technical Reference Manual for Texas Instruments bq20z70, bq20z75, 2007;
11. Technical Reference Manual for Texas Instruments bq20z70, bq20z75, 2008;
12. Technical Reference for Texas Instruments bq20z90, bq20z95 2007.
13. Report of Jason Karasinski, Fire Research and Technology, LLC
14. Report of Andy Litzinger, Fire Research and Technology, LLC
15. Report of Allegheny County Fire Service Investigation
16. Deposition Testimony of Carol Marcellin